Environment Plan

CDN/ID: S4121AF728393

Environment Plan

Thylacine Subsea Installation & Commissioning (T/L2 and T/L4)

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
0	26/08/22	Submission to NOPSEMA	PW	Aventus Consulting	PW
1	02/09/22	Submission to NOPSEMA	PW	Aventus Consulting	PW

Review due	Review frequency
Annually from date of acceptance	Annually (as required)

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

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Acronyms

Terms/acronym	Definition/Expansion
AARNO	Australian Agriculture and Natural Resources Online
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
ALARP	As Low as Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
APPEA	Australian Petroleum Production and Exploration Association
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
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DELWP	Victorian Department of Environment, Land, Water and Planning
DEWHA	Department of the Environment, Water, Heritage, and the Arts
DEWNR	Department of the Environment, Water and Natural Resource
DIIS	Department of Industry, Innovation and Science
DISER	Department of Industry, Science, Energy and Resources

Terms/acronym	Definition/Expansion
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
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	*Environmental Management and Pollution Control Act 1994*
EMT	Emergency Management Team
ENSO	El Niño – Southern Oscillation
EP	Environment Plan
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPO	Environment Performance Outcome
EPS	Environment Performance Standard
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
ETBF	Eastern Tuna and Billfish Fishery
FFG	Flora and Fauna Guarantee Act
GHG	Greenhouse gases
GIS	Geographic Information Systems
GSACUS	Great Southern Australian Coastal Upswelling System
H_2S	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

Terms/acronym	Definition/Expansion
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_2O	Nitrous oxide
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

Terms/acronym	Definition/Expansion
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
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

Terms/acronym	Definition/Expansion
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
WGCMA	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

1.1 Background

The Otway Offshore Project commenced in 2004 by Woodside Petroleum Ltd under a joint venture (JV) arrangement, with first gas produced in mid-2007. In January 2018, Beach Energy (Operations) Ltd (Beach) acquired the Otway Offshore Project assets and is now the operator. The Otway Offshore Project continues the development of the Otway offshore basin natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The Otway Offshore Project will ensure ongoing production at the Otway Gas Plant, which supplies natural gas to Victoria. The Thylacine field is in Commonwealth waters in a depth of approximately 100 metres (m) and is approximately 70 kilometres (km) south of Port Campbell, Victoria. Figure 1-1 provides an overview of the project.

Activities for the Otway Offshore Project have run over several phases beginning with seabed assessments, and then drilling exploration and production wells in the Geographe and Thylacine gas fields, and installation of seabed infrastructure to support tie-in of the wells to the existing Thylacine A Platform (TA) and pipeline.

The current phase (Phase 5) includes the tying in of four new wells in the Thylacine field to the TA and the commissioning of these wells. All activities will occur within permits T/L2 and T/L4. A detailed description of the activity is provided in Chapter 3.

1.2 Scope of the EP

The scope of this Environment Plan (EP) includes the installation of subsea equipment to tie-in four new wells and commissioning activities to connect them to the Otway Gas Plant. The location of these activities is highlighted in yellow in the Planned Petroleum Safety Zone (PSZ) in Figure 1-1. The wells to be connected are:

- Thylacine North-1 (TN-1);
- Thylacine North-2 (TN-2);
- Thylacine West-1 (TW-1); and
- Thylacine West-2 (TW-2).

The activities excluded from this EP:

- Drilling of the wells and the installation of the Christmas Trees (XTs) (per the accepted EP: *Otway Development Drilling and Well Abandonment EP* – link);
- Early dive activities to prepare for tie-in Installation of the Thylacine Diverless Integration Skid (T-DIS) and rigid spools connecting the T-DIS to production and Mono Ethylene Glycol (MEG) facilities at the TA (per the accepted EP: *Otway Phase 5 Early Dive Installation Campaign EP* – link); and
- The operation, inspection and maintenance of the subsea equipment described in this EP (accepted EP: *Otway Offshore Operations EP* – link).

In accordance with Regulation 4(1) of the OPGGS(E), this EP applies to a defined 'petroleum activity.' Beach defines this petroleum activity as the:

> *Installation of subsea equipment to tie-in the four new wells (TN-1, TH-2, TW-1 and TW-2) to the existing T-DIS and TA, and commissioning of these wells. The activity commences from the time the construction vessel first arrives in the activity area to the time the subsea works are complete, and the construction vessel has departed the activity area.*

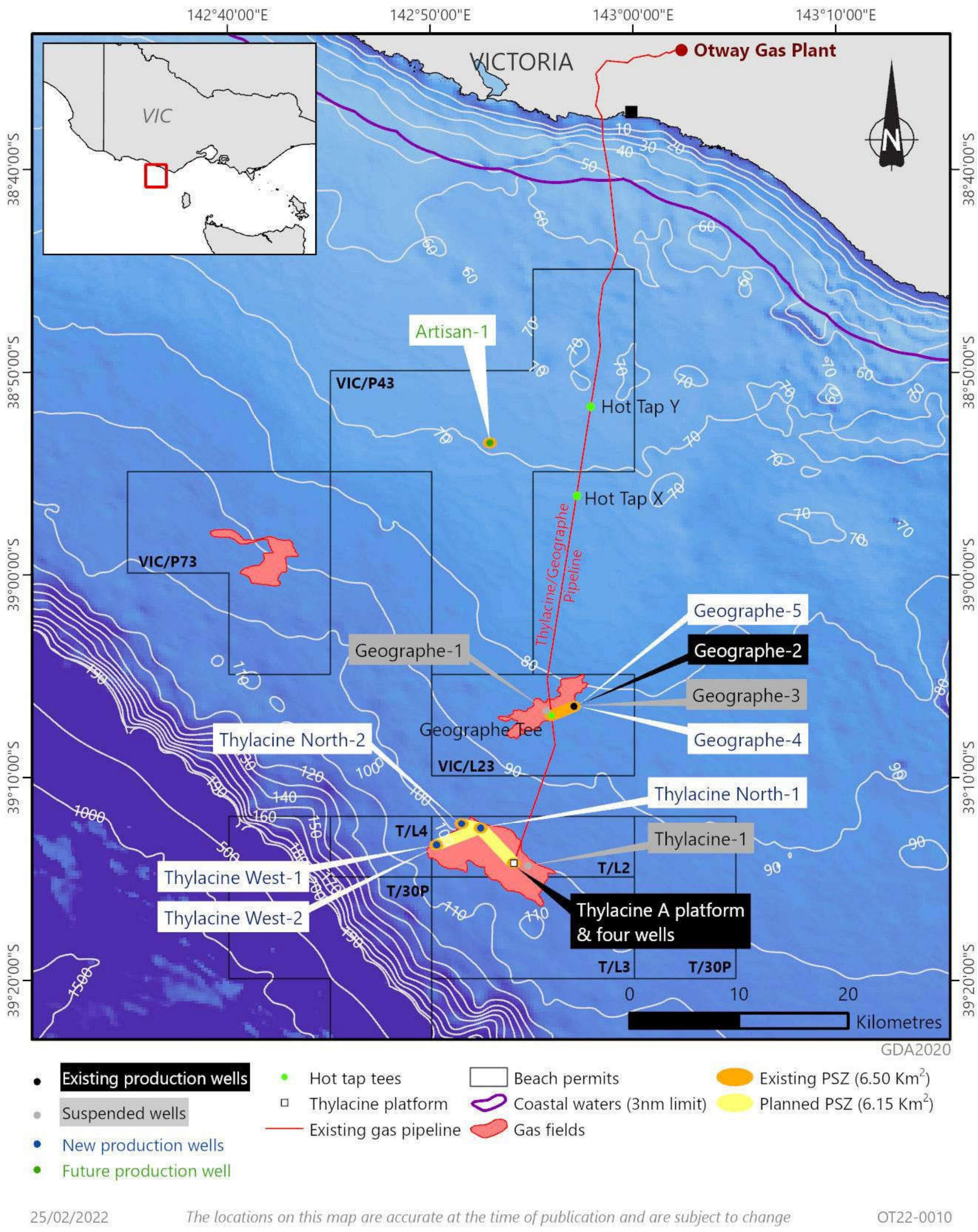


Figure 1-1: The Otway Offshore Project

1.3 The Titleholder

Beach is the titleholder and operator of T/L2 on behalf of several joint venture partners. The composition of the permit holdings is presented in Table 1-1.

Table 1-1: Titleholder details

Titleholder	ACN	Holding
Beach Energy (Operations) Limited	007 845 338	55% (Operator)
OGOG (Otway) Pty Ltd	628 946 752	40%
Beach Energy (Otway) Limited	099 899 395	5%

Beach Energy (Operations) Limited is the sole titleholder of permit T/L4.

The Titleholder for this activity is:

Beach Energy (Operations) Limited
Level 8, 80 Flinders Street, Adelaide, South Australia, 5000
Phone: 08-8338 2833
Email: info@beachenergy.com.au

The nominated liaison person for this EP is:

Philip Wemyss
Beach Principal Environment Advisor
Level 8, 80 Flinders Street, Adelaide, South Australia, 5000
Phone: 08-8338 2833
Email: info@beachenergy.com.au

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

Beach was formed in 1961 and is an Australian Stock Exchange-listed oil and gas, exploration and production company headquartered in Adelaide, South Australia. It has operated and non-operated onshore and offshore oil and gas production from five petroleum 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 is Australia's largest onshore oil producer and a key supplier to the Australian east coast gas market, supplying approximately 15% of the east coast's domestic gas demand, with two offshore production platforms and two gas plants in Victoria.

Figure 1-2: Locations of Beach assets

1.4 Objectives of this EP

As required by Regulation 6 of the OPGGS(E), an EP accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) must be in place prior to any offshore petroleum activity commencing, and that activity must comply with the accepted EP. The objective of this EP is to comply with Regulation 10A of the OPGGS(E) by demonstrating that the EP:

- Is appropriate for the nature and scale of the activity;
- Demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable (ALARP);
- Demonstrates that the environmental impacts and risks of the activity will be of an acceptable level;
- Provides for appropriate environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria;
- Includes an appropriate implementation strategy and monitoring, recording and reporting arrangements;
- Does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any part of a declared World Heritage property within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Demonstrates that:
  - the titleholder has carried out the consultations required by Division 2.2A of the OPGGS(E);
  - the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate; and
- Complies with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and the OPGGS(E).

1.5 Environment Plan Summary

Table 1-2 provides a summary of this EP as required by Regulation 11(4) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (herein referred to as the OPGGS(E)).

Table 1-2: EP Summary of material requirements

EP Summary requirement	Relevant EP section
The location of the activity	Section 3.2
A description of the receiving environment	Chapter 5
A description of the activity	Chapter 3
Details of the environmental impacts and risks	Chapter 7
The control measures for the activity	Chapter 7
The arrangements for ongoing monitoring of the titleholder's environmental performance	Chapter 8
Response arrangements in the oil pollution emergency plan (OPEP)	Chapter 9
Consultation already undertaken and plans for ongoing consultation	Chapter 4
Details of the titleholder's nominated liaison person for the activity	Section 1.3

2 Environmental Management Framework

In accordance with Regulation 13(4) of the OPGGS(E), this chapter describes the legislative requirements that apply to the activities described in this EP.

2.1 Beach's Framework

2.1.1 Operations Excellence Management System (OEMS)

The Beach Operations Excellence Management System (OEMS) will be used to govern this activity. The OEMS provides guidance on how Beach will meet the requirements of its Environmental Policy (Figure 2-1). The Beach OEMS has been developed considering Australian/New Zealand Standard ISO 14001:2016 Environmental Management Systems and is described further in Chapter 8.

2.1.2 Otway Development EPBC Act Approval

The Otway Development was originally approved under Section 133 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to develop the Thylacine and Geographe gas fields (EPBC No. 2002/621) on 13th April 2004. A subsequent 'Variation to conditions attached to approval' (provided by the then Department of the Environment on 22 June 2016) specifies that:

- Condition 8 – if the person taking the action proposes to undertake any subsea tie-in not included in approved plans pursuant to conditions 1, 3, 4 and 5, the person taking the action must revise such plans or submit a new plan or plans so as to address the activities associated with, and potential impacts, 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 been approved the Minister must be implemented.
- Condition 11 – a plan required by condition 1, 3, 5, 8 or 9 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:
  a) Was submitted to NOPSEMA after 27 February 2014; and
  b) Either:
     i. Is in force under the OPGGS Environment Regulations; or
     ii. Has ended in accordance with regulation 25A of the OPGGS Environment Regulations.
- Condition 11B – Where an environment plan which includes measures specified in the conditions referred to in conditions 11 is in force under the OPGGS(E)R that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.

This EP does not, therefore, require an Offshore Project Proposal under Regulation 9 (3)(b) as the activity has been previously approved by the Minister.

2.1.3 NOPSEMA Conditions for the Otway Phase 5 Early Dive Installation Campaign EP

NOPSEMA accepted the Otway Phase 5 Early Dive Installation Campaign EP (link) with conditions on the 16th June 2022. The conditions applying to operations for the Otway Phase 5 Early Dive Installation Campaign are:

Control measure for undertaking the activity in Blue Whale season

1-1 Where the activity is carried out between 1 December 2022 and 30 April 2023, ensure that the following additional requirement will apply to the ***Whale Management Procedure:***

Once the activity has commenced, the distance of the shutdown zone that is part of the Whale Management Procedure will be equal to or greater than the '***distance at which behavioural disturbance of a blue whale is predicted to occur'***.

The definitions applying to this condition are:

- Whale Management Procedure: Whale Management Procedure as documented in Otway Phase 5 Early Dive Installation Campaign Environment Plan, Revision 3, Document number CDN/ID S4130AF725242.
- 'Distance at which behavioural disturbance of a blue whale is predicted to occur': the distance is described in Table 6-4 of the Otway Phase 5 Early Dive Installation Campaign EP as 3.29 km but may be further refined prior to the activity commencing based on in-situ sound level measurements applying the 120 dB re 1 µPa criterion undertaken by independent experts.

For the current EP, the 'distance at which behavioural disturbance of a blue whale is predicted to occur' is 3.65 km (see Section 7.3.3).

2.1.4 Interfaces with Other Documents

This EP interfaces with several other plans, including the:

- Emergency Management Plan (EMP) (CDN/ID 18025990);
- Project HSE Management Plan (CDN/ID S4000AF718818);
- Oil Pollution Emergency Plan – Offshore Victoria – Otway Basin (OPEP) (CDN/ID S4100AH717907); and
- Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908).

These documents describe in detail Beach's emergency management arrangements and the systems in place to manage these risks. Additionally, there will be installation contractor and vessel-specific documents that will interface with this EP.

beach

Environment Policy

Objective

Beach is committed to conducting operations in an environmentally responsible and sustainable manner.

Strategy

To achieve this, Beach will:

- Comply with relevant environmental laws, regulations, and the Beach Health, Safety and Environment Management System which is the method by which Beach identifies and manages environmental risk.
- Establish environmental objectives and targets, and implement programs to achieve them that will support continuous improvement;
- Identify, assess and control environmental impacts of our operations by proactive management of activities and mitigation of impacts;
- Ensure that incidents, near misses, concerns and complaints are reported, investigated and lessons learnt are implemented;
- Inform all employees and contractors of their environmental responsibilities including consultation and distribution of appropriate environmental management guidelines, regulations and publications for all relevant activities;
- Efficiently use natural resources and energy, and engage with stakeholders on environmental issues; and
- Publicly report on our environmental performance.

Application

This policy applies to all personnel associated with Beach activities.

Matt Kay
Managing Director and CEO
December 2019

Figure 2-1: Beach's Environmental Policy

2.2 Legislation

Table 2-1 presents a summary of the key Commonwealth legislation and regulations relevant to the environmental management of the activity, with details of the most pertinent legislation and regulations provided below.

Table 2-1: Summary of key Commonwealth environmental legislation relevant to the activity

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Australian Maritime Safety Authority Act 1990 (AMSA Act)	Facilitates international cooperation and mutual assistance in preparing and responding to major oil spill incidents and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are implemented through the Australian Maritime Safety Authority (AMSA). AMSA is the lead agency for responding to oil spills in the Commonwealth marine environment and is responsible for implementing the Australian National Plan for Maritime Environmental Emergencies ('NatPlan)'. **Relevance to this activity:** In the event of a Level 2 or 3 hydrocarbon spill to sea from the construction vessel during the activity, AMSA may take over from Beach as the Combat Agency and implement the NatPlan.	International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (OPRC). Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances 2000. International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969. United Nations Convention on the Law of the Sea 1982 (UNCLOS) (articles 198 & 221).	AMSA
Australian Ballast Water Management Requirements (Commonwealth of Australia, 2020)	The Australian Ballast Water Management Requirements set out the obligations on vessel operators with regards to the management of ballast water and ballast tank sediment when operating within Australian seas. **Relevance to this activity:** Provides requirements on how vessel operators should manage ballast water when operating within Australian seas to comply with the *Biosecurity Act 2015*.	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 Climate Change, Energy, the Environment and Water (DCCEEW)
Biosecurity Act 2015 (& Regulations 2016)	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. Offshore petroleum installations outside of 12 nm are located outside of Australian territory for the purposes of the Act. While these installations are not subject to biosecurity control, aircraft and vessels (not subject to biosecurity control) that leave Australian territory and are exposed to the installations are subject to biosecurity control when returning to Australian territory. When a vessel or aircraft leaves Australian territory and interacts with an installation or petroleum industry vessel it becomes an 'exposed	International Convention for the Control and Management of Ships' Ballast Water & Sediments 2004. World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (SPS agreement). World Organisation for Animal Health and the International Plant Protection Convention.	DCCEEW

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	conveyance' and is subject to biosecurity control when it returns to Australian territory unless exceptions can be met. The person in charge of an exposed conveyance carries the responsibility for pre-arrival reporting under the Act and must arrive at a first point of entry. This Act includes mandatory controls in the use of seawater as ballast in ships and the declaration of sea vessels voyaging into and out of Commonwealth waters. The regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers. **Relevance to this activity:** The construction vessel sourced from foreign ports will adhere to the DCCEEW guidelines regarding quarantine clearance to enter Australian waters.		
Environment Protection (Sea Dumping) Act 1981 (& Regulations 1983)	Aims to prevent the deliberate disposal of wastes (loading, dumping, and incineration) at sea from vessels, aircraft, and platforms. **Relevance to this activity:** There will be no dumping at sea within the meaning of the legislation that would require a sea dumping permit to be obtained.	Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (London Convention). Protocol on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1996 (London Protocol).	DCCEEW
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (& Regulations 2000)	Protects MNES, provides for Commonwealth environmental assessment and approval processes and provides an integrated system for biodiversity conservation and management of protected areas. The nine MNES are: 1. World heritage properties; 2. National heritage places; 3. Wetlands of international importance (Ramsar wetlands); 4. Nationally threatened species and ecological communities; 5. Migratory species; 6. Commonwealth marine environment; 7. The Great Barrier Reef Marine Park; 8. Nuclear actions (including uranium mining); and 9. A water resource, in relation to coal seam gas development and large coal mining development.	Convention on Biological Diversity and Agenda 21 1992. Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES). 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 (JAMBA). 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 (CAMBA). Republic of Korea Migratory Birds Agreement 2006 (ROKAMBA). Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 (Ramsar). International Convention for the Regulation of Whaling 1946.	DCCEEW (NOPSEMA in the case of this activity)

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	Relevance to this activity: This EP includes a description and assessment of the MNES that may be impacted by the activity (principally items 4 and 5 in this list).	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.	
Fisheries Management Act 1991 (& Regulations 2009)	This Act aims to implement efficient and cost-effective fisheries management on behalf of the Commonwealth, ensure that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of Ecologically Sustainable Development (ESD), maximise the net economic returns to the Australian community from the management of Australian fisheries, ensure accountability to the fishing industry and to the Australian community in the Australian Fisheries Management Authority's (AFMA's) management of fisheries resources, and achieve government targets in relation to the recovery of the costs of AFMA. **Relevance to this activity:** Provides the regulatory and other mechanisms to support any necessary fisheries management decisions in the event of a hydrocarbon spill in Commonwealth waters.	Not applicable.	AFMA
National Greenhouse and Energy Reporting Act 2007 (NGER) (& Regulations 2008)	Establishes the legislative framework for the NGER Scheme, which is a national framework for reporting GHG emissions, GHG projects and energy consumption and production by corporations in Australia. **Relevance to this activity:** Beach is a registered reporter under this Act (ABN 200 076 179 69). Under the NGER Act, a controlling corporation assesses its reporting obligations by reference to the facilities that are under its 'operational control.' As the vessel contractor/s does not come under Beach's operational control, it/they will be required to collect and submit their own emissions data under the NGER Act.	UNFCCC 1994.	Clean Energy Regulator
Navigation Act 2012 (& Regulations 2013)	This Act regulates ship-related activities in Commonwealth waters and invokes certain requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) relating to equipment and construction of ships. Several Marine Orders (MO) are enacted under this Act relating to the environmental and social management of offshore petroleum activities, including: MO 21 - Safety and emergency arrangements.	United Nations Convention on the Law of the Sea 1982 (UNCLOS). International Convention for the Safety of Life at Sea 1974 (SOLAS). Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREG).	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	MO 30 - Prevention of collisions. MO 50 - Special purpose vessels. MO 70 – Seafarer certification. **Relevance to this activity**: The construction vessel will adhere to the relevant MOs while operating within Commonwealth waters.	International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL). International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as amended, 1995.	
Offshore Petroleum and Greenhouse Storage Act 2006 (OPGGS Act) and OPGGS (E)	The Act addresses all licensing and HSE issues for offshore petroleum and GHG activities extending beyond the 3 nm limit. The Regulations (Part 2) specify that an EP must be prepared for any GHG activity and that activities are undertaken in an ecologically sustainable manner. **Relevance to this activity:** The preparation and acceptance of this EP satisfies the key requirements of this legislation.	Not applicable.	NOPSEMA
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	Regulates the manufacture, importation and use of ozone depleting substances. **Relevance to this activity:** The construction vessel will have a register of ozone-depleting substances (ODS).	Montreal Protocol on Substances that Deplete the Ozone Layer 1987. United Nations Framework Convention on Climate Change (UNFCCC) 1994.	DCCEEW
Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008	Sets up a compensation scheme for those who suffer damage caused by spills of oil that is carried as fuel in ships' bunkers. There is an obligation on ships >1,000 gross tonnes to carry insurance certificates when leaving/entering Australian ports or leaving/entering an offshore facility within Australian coastal waters. **Relevance to this activity:** The construction vessel will hold the necessary insurance certificates, as required.	International Convention on Civil Liability for Bunker Oil Pollution Damage 2001.	AMSA
Protection of the Sea (Harmful Antifouling Systems) Act 2006	Creates an offence for a person to engage in negligent conduct that results in a harmful anti-fouling compound being applied to a ship. Also provides that Australian ships must hold 'anti-fouling certificates', provided they meet certain criteria. **Relevance to this activity:** The construction vessel will hold valid anti-fouling certificates, as required.	International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001.	AMSA
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POSPOPS Act)	Regulates ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. It requires that ships >400 gross tonnes have pollution emergency	Various parts of MARPOL. See also Table 2-2 for further information.	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994	plans. Several MO are enacted under this Act relating to offshore petroleum activities, including: MO 91: Marine Pollution Prevention – Oil MO 93: Marine Pollution Prevention – Noxious liquid substances MO 94: Marine Pollution Prevention – Packaged harmful substances MO 95: Marine Pollution Prevention – Garbage MO 96: Marine Pollution Prevention – Sewage MO 97: Marine Pollution Prevention – Air Pollution MO 98: Marine Pollution Prevention – Anti-fouling Systems. **Relevance to this activity:** The construction vessel will adhere to the relevant MOs by having a SMPEP, Oil Record Book and Garbage Management Plan in place and implemented, along with international pollution prevention certificates verifying compliance with oil, air pollution and sewage measures.		
Underwater Cultural Heritage Act 2018	Protects the heritage values of shipwrecks, sunken aircraft and relics (older than 75 years) in Australian Territorial waters below the low water mark to the outer edge of the continental shelf (excluding the State's internal waterways. It is an offence to interfere with a shipwreck covered by this Act. **Relevance to this activity:** Historic shipwrecks are mapped in the EMBA (but not in the activity area). In the event of the discovery of, and damage to previously unrecorded wrecks, this legislation may be triggered.	Agreement between the Netherlands and Australia concerning old Dutch Shipwrecks 1972.	DCCEEW

2.3 Victorian Legislation

No part of the activity occurs within Victorian state waters and as such, no environmental approvals for the activity are required from the Victorian government. However, Victorian legislation would be relevant in the case of a large hydrocarbon release, as the environment that may be affected (EMBA) by a diesel spill intersects Victorian waters (see start of Chapter 5). Victorian legislation relevant to marine pollution in Victorian state waters includes:

- *Pollution of Waters by Oil and Noxious Substances Act 1986* (POWBONS) – designed to protect State waters from pollution by oil and other substances and to give effect to Annex I of the MARPOL convention. This Act restricts the discharge of treated oily bilge water according to vessel classification, discharge of cargo substances or mixtures, garbage disposal and packaged harmful substances, and sewage. The Act requires mandatory reporting of marine pollution incidents.

- *Emergency Management Act 2013* – provides for the establishment of governance arrangements for emergency management in Victoria, including the Office of the Emergency Management Commissioner and an Inspector-General for Emergency Management. Provides for integrated and comprehensive prevention, response and recovery planning, involving preparedness, operational coordination and community participation, in relation to all hazards. These arrangements are outlined in the Emergency Management Manual Victoria.

- *Marine (Drug, Alcohol and Pollution) Act 1988* – defines prohibited discharges (refer to POWBONS), and allocates roles, responsibilities and liabilities to ensure there is a capacity and obligation (i.e., Director – Transport Safety, public statutory body) to respond to marine incidents which have the potential, or do, result in pollution. The Victorian Marine Pollution Contingency Plan (EMV, 2016) is prepared under this Act.

- *Environment Protection Act 1970* – this is the key Victorian legislation that controls discharges and emissions (air, water) to the Victorian environment (including state and territorial waters). It gives the Environment Protection Authority (EPA) powers to control marine discharges and to undertake prosecutions. It provides for the maintenance and, where necessary, restoration of appropriate environmental quality.

- *Flora and Fauna Guarantee Act 1988* (FFG Act) – this Act protects rare and threatened species and provides for a choice of procedures that can be used for the conservation, management or control of flora and fauna and the management of potentially threatening processes. Where a species has been listed as threatened, an Action Statement is prepared setting out the actions that have been or need to be taken to conserve and manage the species and community.

- *Seafood Safety Act 2003* – this Act provides a regulatory system under which all sectors in the seafood supply chain are required to manage food safety risks. This could be triggered in the unlikely event that a hydrocarbon spill results in impacts to commercial fisheries or the prevention of sale of seafood caught in waters affected by a spill.

- *National Parks Act 1975* – activities within Marine National Parks and Marine Sanctuaries require Ministerial consent before activities (such as oil spill response) are carried out.

- *Wildlife Act 1975* – promotes the protection and conservation of wildlife and prohibits and regulates persons authorised to engage in activities relating to wildlife (including incidents). The regulations 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)).

2.4 Tasmanian Legislation

No part of the activity occurs within Tasmanian state waters and as such, no environmental approvals for the development are required from the Tasmanian government. Tasmanian legislation is only relevant to this EP in the case of a large hydrocarbon release, as the diesel spill EMBA intersects areas of Tasmanian waters (around some Bass Strait islands only). Tasmanian legislation relevant to marine pollution in Tasmanian state waters includes:

- *Pollution of Waters by Oil and Noxious Substances Act 1987* – designed to protect State waters from pollution by oil and other substances and to give effect to certain parts of the MARPOL convention.
- *Environmental Management and Pollution Control Act 1994* – provides for the management of the environment and the control of pollution.
- *Emergency Management Act 2006* – provides for the protection of life, property and the environment in a declared State emergency by outlining prevention, preparedness, response and recovery procedures.
- *Tasmanian Ports Corporation Act 2005* – sets out administrative arrangements for the Tasmanian Ports Corporation Pty Ltd.
- *Marine and Safety Authority Act 1997* – sets out powers to ensure the safe operation of vessels in Tasmanian state waters.

2.5 Government Guidelines

This EP has been developed in accordance with the NOPSEMA Guidance Note for *Environment Plan Content Requirements* (N04750-GN1344, A339814, September 2020). This document provides guidance to the petroleum industry on NOPSEMA's interpretation of the OPGGS(E) to assist titleholders in preparing EPs.

Other relevant government guidelines that have been incorporated or taken into consideration during the preparation of this EP include:

<u>EPs</u>

- Environment plan assessment (NOPSEMA Policy N-04750-PL1347, May 2020).
- Reducing marine pest biosecurity risks through good practice biofouling management (NOPSEMA Information Paper N-04750-IP1899, July 2020).
- Environment plan decision making (NOPSEMA Guideline N-04750-GL1721, June 2021).
- Oil spill modelling (NOPSEMA Environment Bulletin, April 2019).
- Acoustic impact evaluation and management (NOPSEMA Information Paper, N-04750-IP1765, June 2020).
- Guidance on key terms within the Blue Whale Conservation Management Plan, September 2021 (DAWE and NOPSEMA).
- Petroleum activities and Australian marine parks (NOPSEMA Guidance Note, N-04750-GN1785, Rev 0, June 2020).

<u>OPEPs</u>

- Oil pollution risk management (NOPSEMA Guidance Note N-04750-1488, July 2021).
- Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, January 2015).
- Advisory Note Offshore Petroleum Industry Oil Spill Contingency Planning Consultation (Victorian Department of Transport, Planning and Local Infrastructure, Version 2.0, August 2013).

- Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans (AMSA, 2012).

OSMPs

- Operational and scientific monitoring programs (NOPSEMA Information Paper, N-04750-IP1349, October 2020).

EPBC Act

- EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (DoE, 2013).
- EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (DEWHA, 2008).

2.6 Government Management Plans

The EPS provided throughout Chapter 7 of this EP have taken into account various government management plans, generally under the categories of:

- AMP management plans;
- State coastal park management plans; and
- Recovery Plans, Conservation Plans and Conservation Advice for species threatened at the Commonwealth and/or state levels.

2.7 International Industry Codes of Practice and Guidelines

A number of international codes of practice and guidelines are relevant to environmental management of the activity. Those of most relevance are described here. The Commonwealth legislation described in Table 2-1 lists the conventions and agreements that are enacted by, or whose principles are embodied in, that legislation.

While none of the codes of practice or guidelines described in this section have legislative force in Australia (with the exception of MARPOL), they are considered to represent best practice environmental management (BPEM). Aspects of each code or guideline relevant to the impacts and risks presented by the activity are outlined throughout Chapter 7.

2.8 MARPOL

The key international convention relating to marine environmental matters is the International Convention for the Prevention of Pollution from Ships (MARPOL). This convention was adopted in November 1973 by the International Maritime Organisation (IMO), with ongoing additions and amendments. MARPOL aims to prevent and minimise pollution (routine discharges and accidents) from ships generally larger than 400 gross tonnes.

In Australian Commonwealth waters, MARPOL is given effect through the *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 and via Marine Orders made under the *Navigation Act* 2012 and is administered by AMSA. Table 2-2 lists the annexes of the Convention and identifies how they are given effect under Commonwealth legislation (with Victorian and Tasmanian legislation also included in the event of ingress into State waters being required in an emergency situation).

2.8.1 Environmental Management in the Upstream Oil and Gas Industry (2020)

These guidelines were released in August 2020 by the International Association of Oil & Gas Producers (IOGP) and the International Petroleum Industry Environmental Conservation Association (IPIECA). They supersede the United Nations Environment Programme Industry and Environment (UNEP IE) Environmental Management in Oil and Gas Exploration and Production guidelines released in 1997 prepared by the International Exploration and Production Forum (E&P Forum), the precursor to IOGP.

These guidelines provide descriptions of upstream oil and gas activities environmental management practices. Chapter 4 of the guidelines lists the environmental impacts and mitigation measures associated with offshore activities, and provide a useful benchmark for BPEM for this activity.

2.8.2 Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (2019)

The *Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production* (European Commission, 2019) aims to identify best available techniques (BAT) and best risk management approaches for key environmental issues associated with onshore and offshore oil and gas exploration and production activities. The BATs included are not prescriptive nor exhaustive but included as a point of comparison with documents such as this EP to ensure the desired environmental outcomes commensurate with BAT can be achieved for the European context.

2.8.3 Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (2015)

The *Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development* (World Bank Group, 2015) is a technical reference document with general and industry-specific examples of good international industry practice. These guidelines are applied when one or more members of the World Bank Group are involved in a project.

The document contains measures considered to be achievable in new facilities, using existing technology, at reasonable costs. The guidelines are designed to be tailored to the applicable hazards and risks established for a given project.

While the World Bank Group is not involved in financing or assessing this activity, control measures adopted for this activity that adhere to these guidelines can be referenced as examples of BPEM.

Table 2-2: Commonwealth, Victorian and Tasmanian legislation enacting the MARPOL Convention

Annex (entry into force in Australia)	Commonwealth waters (POSPOPS Act 1983 & *Navigation Act* 2012)	Victorian waters (POWBONS Act 1986)	Tasmanian waters (POWBONS Act 1987)	General operating requirements
I Regulations for the Prevention of Pollution by Oil (1988)	AMSA MO 91; Marine Pollution Prevention – Oil.	Part 3, Division 2 – Prevention of pollution from ships Convention (ships carrying or using oil).	Part 2, Division 1 – Prevention of pollution from ships (Pollution by oil).	Addresses measures for preventing pollution by oil from regulated Australian vessels or foreign vessels, and specifies that: An International Oil Pollution Prevention (IOPP) certificate is required; A Shipboard Marine Pollution Emergency Plan (SMPEP) is required; An oil record book must be carried; Oil discharge monitoring equipment must be in place; and Incidents involving oil discharges are reported to AMSA.
II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (1988)	AMSA MO 93; Marine Pollution Prevention – Noxious Liquid Substances.	Part 3, Division 3 – Prevention of pollution from ships Convention (ships carrying noxious liquid substances in bulk).	Part 2, Division 2 – Prevention of pollution from ships (Pollution by noxious substances).	Addresses measures for preventing pollution by 250 noxious liquid substances carried in bulk from regulated Australian vessels or foreign vessels, and specifies that: An International Pollution Prevention (IPP) certificate is required; A SMPEP is required; A cargo record book must be carried; Incidents involving noxious liquid substance discharges are reported to AMSA; The discharge of residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with; and No discharge of residues containing noxious substances is permitted within 12 nm of the nearest land.
III Prevention of Pollution by harmful Substances Carried by Sea in Packaged Form (1995)	AMSA MO 94; Marine Pollution Prevention – Packaged Harmful Substances	Part 3, Division 4 – Ships carrying harmful substances.	Part 2, Division 2A – Prevention of pollution from ships (Pollution by packaged harmful substances).	Addresses measures for preventing pollution by packaged harmful substances (as defined in the International Marine Dangerous Goods (IMDG) code, which are dangerous goods with properties adverse to the marine environment, in that they are hazardous to marine life, impair the taste of seafood and/or accumulate pollutants in aquatic organisms) from regulated Australian vessels or foreign vessels, and specifies that: The packing, marking, labelling and stowage of packaged harmful substances complies with Regulations 2 to 5 of MARPOL Annex III; A copy of the vessel manifest or stowage plan is provided to the port of loading prior to departure; Substances are only washed overboard if the Vessel Master has considered the physical, chemical and biological properties of the substance; and

Annex (entry into force in Australia)	Commonwealth waters (POSPOPS Act 1983 & *Navigation Act* 2012)	Victorian waters (POWBONS Act 1986)	Tasmanian waters (POWBONS Act 1987)	General operating requirements
				Incidents involving discharges of dangerous goods are reported to AMSA.
IV Prevention of Pollution by Sewage from Ships (2004)	AMSA MO 96; Marine Pollution Prevention – Sewage.	Part 3, Division 5 – Sewage pollution prevention certificates.	Part 2, Division 2AB – Prevention of pollution from ships (Pollution by sewage).	Addresses measures for preventing pollution by sewage from regulated Australian vessels or foreign vessels, and specifies that: An International Sewage Pollution Prevention (ISPP) is required; The vessel is equipped with a sewage treatment plant (STP), sewage comminuting and disinfecting system and a holding tank approved by AMSA or a recognised organisation; The discharge of sewage into the sea is prohibited, except when an approved STP is operating or when discharging comminuted and disinfected sewage using an approved system at a distance of more than 3 nm from the nearest land; and Sewage that is not comminuted or disinfected has to be discharged at a distance of more than 12 nm from the nearest land.
V Prevention of Pollution by Garbage from Ships (1990)	AMSA MO 95; Marine Pollution Prevention – Garbage. * Not made under the *Navigation Act* 2012.	Part 2, Division 2A – Prevention of pollution by garbage.	Part 2, Division 2B – Prevention of pollution from ships (Pollution by garbage).	Addresses measures for preventing pollution by garbage from regulated Australian vessels or foreign vessels, and specifies that: Prescribed substances (as defined in the IMO 2012 Guidelines for the Implementation of MARPOL Annex V) must not be discharged to the sea; A Garbage Management Plan must be in place; A Garbage Record Book must be maintained; Food waste must be comminuted or ground to particle size <25 mm while en route and no closer than 3 nm from the nearest land (or no closer than 12 nm if waste is not comminuted or ground); and It is prohibited to discharge wastes including plastics, cooking oil, packing materials, glass and metal.
VI Prevention of Air Pollution from Ships (2007)	AMSA MO 97; Marine Pollution Prevention – Air Pollution.	Indirectly through the State Environment Protection Policy (Air Quality Management) under the *Environment Protection Act* 1970: Clause 33 (Management	*Environmental Management and Pollution Control Act* 1994 Environmental Protection Policy (Air Quality) 2004	Addresses measures for preventing air pollution from regulated Australian vessels or foreign vessels, and specifies that: An International Air Pollution Prevention (IAPP) certificate is in place; An Engine International Air Pollution Prevention (EIAPP) certificate is in place for each marine diesel engine installed; An International Energy Efficiency (IEE) certificate is in place; Specifies that incineration of waste is permitted only through a MARPOL-compliant incinerator, with no incineration of Annex I, II and III cargo residues, polychlorinated biphenyls

Annex (entry into force in Australia)	Commonwealth waters (POSPOPS Act 1983 & *Navigation Act* 2012)	Victorian waters (POWBONS Act 1986)	Tasmanian waters (POWBONS Act 1987)	General operating requirements
		of Greenhouse Gases). Clause 35 (Management of Ozone Depleting Substances (ODS)). Clause 36 (Management of other Mobile Sources).		(PCBs), garbage containing traces of heavy metals, refined petroleum products and polyvinyl chlorides (PVCs); Marine incidents are reported to AMSA; Sulphur content of fuel oil is no greater than 3.5% m/m; A bunker delivery note must be provided to the vessel on completion of bunkering operations, with a fuel oil sample retained; and Emissions of ODS must not take place and an ODS logbook must be maintained.

2.8.4 IOGP Best Practice Guidelines

The IOGP has a membership including companies that produce more than one-third of the world's oil and gas. The IOGP provides a forum where members identify and share knowledge and good practices to achieve improvements in health, safety, environment, security and social responsibility. The IOGP's aim is to work on behalf of oil and gas exploration and production companies to promote safe, responsible and sustainable operations. The IOGP's work is embodied in publications that are made freely available on its website (www.iogp.org). Beach is an IOGP member and the relevant guidelines have been referenced in this EP (and associated OPEP) to support the oil spill response strategies.

2.8.5 IPIECA Best Practice Guidelines

The International Petroleum Industry Environmental Conservation Association's (IPIECA's) vision is for an oil and gas industry whose operations and products meet society's environmental and social performance expectations, with a focus on the key areas of climate and energy, environment, social and reporting. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance. IPIECA's work is embodied in publications that are made freely available on its website (www.ipieca.org).

Relevant guidelines have been referenced in this EP (and associated OPEP), primarily in the areas of atmospheric emissions and oil spill response and preparedness.

Beach has applied IPIECA's recent *Mapping the Oil and Gas Industry to the Sustainable Development Goals: An Atlas* (July 2017) to the activity. Goal 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) is the most relevant to this activity, and has been met by fulfilling the following:

- Incorporating environmental assessments into management plans – this EP satisfies this sub-goal; and
- Accident prevention, preparedness and response – the OPEP and OSMP demonstrate that Beach takes prevention, preparedness and response seriously and is well prepared to act in the event of an environmental emergency.

2.8.6 ITOPF Oil Spill Response Technical Information Papers

The International Tanker Owners Pollution Federation Limited (ITOPF) was established to promote effective response to marine spills of oil, chemicals and other hazardous substances by providing five core services (spill response, claims analysis and damage assessment, information services, contingency planning and advice and training and education). Membership of ITOPF comprises owners or demise charterers of tankers, defined as any ship (whether or not self-propelled) designed, constructed or adapted for the carriage by water in bulk of crude petroleum, hydrocarbon products or other liquid substances.

Although the ITOPF definition of a tanker excludes vessels such as those to be used for this activity, its series of Technical Information Papers (relating to marine pollution, contingency planning for marine oil spills and responding to oil spills) have been referenced in this EP (and associated OPEP) to support the oil spill response strategies.

2.9 Australian Industry Codes of Practice and Guidelines

There are few Australian industry codes of practice or guidelines regarding environmental management for offshore petroleum exploration. Those that do apply to this activity are briefly discussed in this section.

None of these codes of practice or guidelines have legislative force in Australia (other than the EPBC Act Policy Statement 2.1) but are considered to represent BPEM. Aspects of each code or guideline relevant to the impacts and risks presented by the activity are described in the 'demonstration of acceptability' throughout Chapter 7.

2.9.1 National Strategy for Ecologically Sustainable Development (1992)

The National Strategy for Ecologically Sustainable Development (ESDSC, 1992) defines the goal of Ecologically Sustainable Development (ESD) as "*development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends*."

Section 3A of the EPBC Act defines the principles of ESD as:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- The 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 conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
- Improved valuation, pricing and incentive mechanisms should be promoted.

The ESD concept has been taken into consideration in the development of the EPS and demonstration of acceptability in this EP.

2.9.2 APPEA Code of Environmental Practice (2008)

In Australia, the petroleum exploration and production industry operates within an industry code of practice developed by the Australian Petroleum Production and Exploration Association (APPEA); the *APPEA Code of Environmental Practice* (CoEP) (2008). This code provides guidelines for activities that are not formally regulated and have evolved from the collective knowledge and experience of the oil and gas industry, both nationally and internationally.

The APPEA CoEP covers general environmental objectives for the industry, including planning and design, assessment of environmental risks, emergency response planning, training and inductions, auditing and consultation, and communication. For the offshore sector specifically, it covers issues relating to geophysical surveys, drilling, development and production.

The APPEA CoEP has been used as a reference for the impact and risk assessment (Chapter 7 of this EP) to ensure that all necessary environmental issues and controls for petroleum exploration have been incorporated into the management of this activity.

2.9.3 Australian Ballast Water Management Requirements (2020)

The *Australian Ballast Water Management Requirements* (DAWE, 2020, v8) detail the mandatory ballast water management requirements and provide information on ballast water pump tests, reporting and exchange calculations. The measures outlined in this EP are designed to minimise the risk of introducing harmful aquatic organisms into Australian waters.

2.9.4 National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009)

The *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (DAFF, 2009) provides a generic approach to a biofouling risk assessment and practical information on managing biofouling on hulls and niche areas.

The measures outlined in this EP are designed to minimise the risk of introducing harmful aquatic organisms into Australian waters.

2.9.5 National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (2017)

The *National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna* (DoEE, 2017a) provides a framework for identifying megafauna species (principally whales, dolphins, turtles and whale sharks) most at risk from vessel collision and outlines mitigation measures to reduce this risk.

The measures outlined in this EP are designed to minimise the risk of colliding with megafauna.

2.9.6 Australian National Guidelines for Whale and Dolphin Watching (2017)

The *Australian National Guidelines for Whale and Dolphin Watching* (DoEE, 2017b) principally apply to commercial marine tourism operations involves in whale and dolphin watching, outlining measures to comply with the EPBC Act and minimise disturbance to these cetaceans.

In the context of this activity, Beach applies these guidelines to the construction vessel so that approach distances to cetaceans are adhered to.

3 Activity Description

In accordance with Regulation 13(1) of the OPGGS(E), this chapter provides a description of the proposed activity.

The current phase (Phase 5) includes the tying in of four new wells in the Thylacine field to the TA and the commissioning of these wells to connect gas supply to the Otway Gas Plant.

3.1 Location

The activity will take place within Beach-operated permits T/L2 and T/L4, which are in Commonwealth waters approximately 70 km south of Port Campbell. The activity area is defined as:

> *A polygon, with points defined by the Thylacine A Platform and the four well locations in* Table 3-1*, with a 500 m buffer.*

Figure 3-1 shows the activity location and the area where the activity is proposed to occur.

The activity area is approximately 65 km southwest of Cape Otway and approximately 90 km northwest of King Island.

3.2 Timing

The installation and commissioning activity is planned to occur between 1st December 2022 and 31st May 2023, with the contracted vessel mobilised prior to this time. The activity will take up to 60 days to complete, depending on sea state conditions and technical matters.

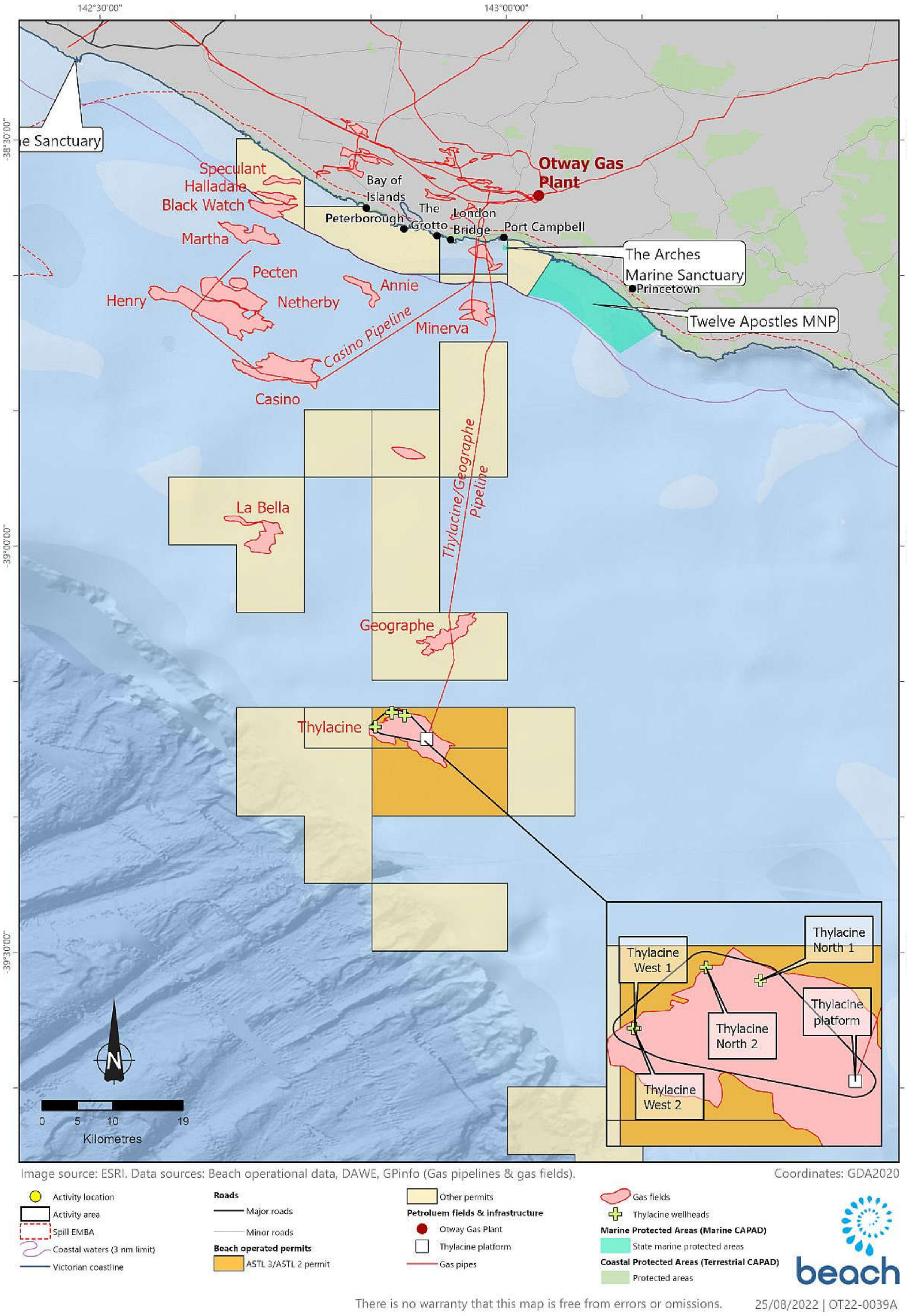


Figure 3-1: Proposed Thylacine installation and commissioning activity area

3.3 Existing Infrastructure

The existing infrastructure in the activity area associated with the activities described in this EP is shown in Figure 3-2 and includes:

- Pre-existing infrastructure: TA (shown as yellow);
- Phase 4 additions: XTs at the four well locations (shown as green); and
- Phase 4+ Early dive campaign (shown as light blue):
  - Thylacine T-DIS (fluid filled with a mix of inhibited potable water or seawater and Mono Ethylene Glycol (MEG) (80%).
  - Rigid production spool connecting the TA to the T-DIS (filled with a mix of inhibited potable water or seawater and Mono Ethylene Glycol (MEG) (80%).
  - MEG spool connecting the TA to the T-DIS filled with a mix of inhibited potable water or seawater and MEG (80%).
  - Concrete protection mattresses over the production and MEG spools.

The coordinates of the existing infrastructure relevant to this activity are presented in Table 3-1.

Table 3-1: Coordinates of Thylacine infrastructure in the activity area

Subsea infrastructure	Latitude	Longitude
Thylacine-A Platform (TA)	39º 14.241' S	142º 54.126' E
Thylacine North-1 well (TN-1)	39° 12.510' S	142° 52.496' E
Thylacine North-2 well (TN-2)	39° 12.284’ S	142° 51.557’ E
Thylacine West-1 well (TW-1)	39° 13.338' S	142° 50.318' E
Thylacine West-2 well (TW-2)	39° 13.332' S	142° 50.310' E
T-DIS	39º 14.245' S	142º 54.091' E

All coordinates are approximate and provided as GDA94.

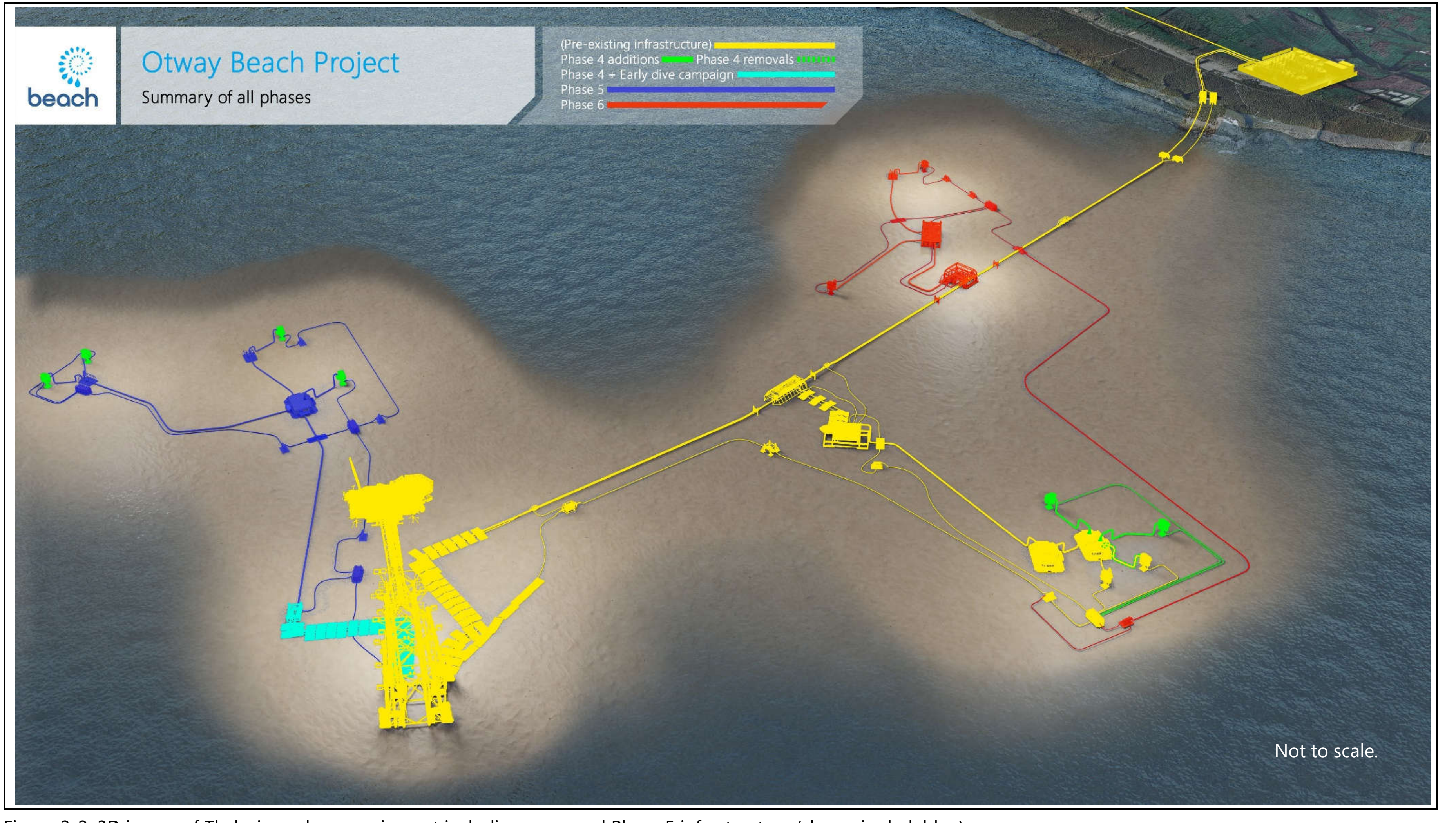


Figure 3-2: 3D image of Thylacine subsea equipment including proposed Phase 5 infrastructure (shown in dark blue)

3.4 New Infrastructure

The new infrastructure to be installed as part of the activity is shown (generically) as dark blue in Figure 3-2 and in more detail in Figure 3-3. Table 3-2 provides approximate dimensions and weights of the infrastructure to be installed. The total footprint of the installed equipment is approximately 6,000 m^2.

Table 3-2: Infrastructure to be installed

Fixed Materials	**L x W x H (m)**	**Mass (t)**
TN-1 Manifold	11.8 x 10.6 x 4.3	77
TN-2 Flowline End Termination **(**FLET)	9.3 x 8.9 x 4.3	63
TW Flowline End Manifold **(**FLEM)	9.3 x 8.9 x 4.3	63
TN-1 Rigid Spool	25.0 x 2.0 x 6.0	10
TN-2 Rigid Spool	25.0 x 2.0 x 6.0	10
TW-1 Rigid Spool	25.0 x 2.0 x 6.0	10
TW-2 Rigid Spool	25.0 x 2.0 x 6.0	10
Concrete mattresses (approx. 50)	6.0 x 2.5 x 0.30 (750 m^2 x 0.3 m H)	6.2 each (310 total)
Umbilicals and Flowlines	**Length/Diameter**	
TA-WHP Electrohydraulic Umbilical (EHU)	391 m @ 133 mm	
TN-1 EHU	3,974 m @ 177 mm	
TN-2 EHU	1,684 m @ 177 mm	
TW EHU	4,356 m @ 177 mm	
Production Flowlines (PFL)	4,177 m @ 10" ID	
	4,154 m @ 8" ID	
	1,526 m @ 6" ID	
Flying Leads	**Length (total)**	
Electrical Flying Leads (EFLs)	480 m (8 @ 60 m)	
Hydraulic Flying Leads (HFLs)	240 m (4 @ 60 m)	
MEG Jumper	150 m (1 @150 m)	
Wet Gas Flow Meter (WGFM) Flying Leads	160 m (4 @ 40 m)	

Following on from the installation activities, pre-commissioning and cold commissioning of the following Otway Phase 5 subsea systems will occur:

- Production system from the XTs to the T-DIS;
- MEG distribution system from the T-DIS to the XTs;
- Hydraulic system from the Thylacine Topside Umbilical Termination Unit (TUTU) to the XTs;
- Chemical injection system from the Thylacine TUTU to the XTs; and
- Power and signal system from the Thylacine Junction Box (JB) to the Subsea Control Modules (SCMs) on the XTs.

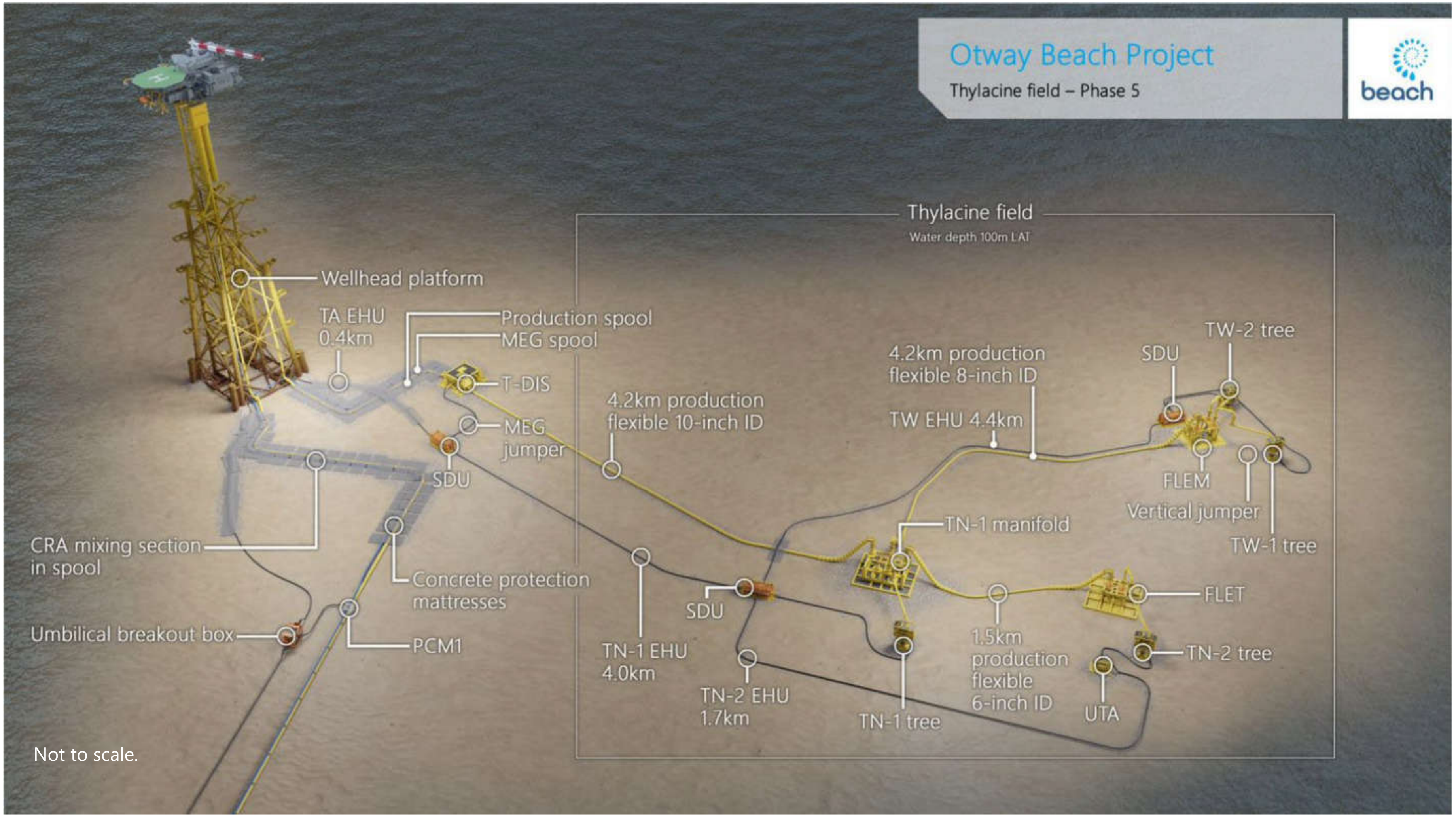


Figure 3-3: 3D image of Thylacine Phase 5 subsea equipment showing individual components

3.5 Construction Support Vessel CSV)

A purpose-built CSV, the *Skandi Acergy,* is likely to be used for this activity (Figure 3-4). The *Skandi Acergy* is a Class III dynamic positioning (DP) vessel with two active heave compensated (AHC) cranes, two work-class remotely operated vehicles (ROVs) integrated to provide safe and efficient launch capability in a wide range of sea states, and a 3000Te below deck storage carousel. The CSV will be manned by approximately 100 people, including 25 marine crew.

The CSV can carry 2,306 m^3 of fuel (largest tank is 603.7 m^3) and will not have to refuel at sea. No anchoring will occur during the activity. As the activity area is in approximately 100 m water depth, there is no credible risk of a grounding occurring.

In line with the NOPSEMA accepted CSV Safety Case, all works in vicinity of the operating TA must be completed such that the CSV always remains in drift-off/drift-by condition (i.e., not in a drift-on position). Detailed engineering will assess prevailing conditions and where possible allow for CSV positioning that reduces the likelihood of this impacting operations with checks (e.g., drift test) completed on site by the Vessel Master to confirm suitability.

Figure 3-4: The *Skandi Acergy*

3.5.1 Vessel Environmental Credentials

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. Due diligence regarding the CSV's environmental records and performance will be conducted by Beach after contract award through inspection of the vessel's Common Marine Inspection Document (CMID) (as developed by the International Marine Contractors Association, IMCA) or similar. Beach will have a Client Representative onboard to provide quality assurance of the installation process and assist with implementation of the EP commitments.

The CSV will be required to meet pollution prevention requirements under the MARPOL Convention, as enacted by the *Navigation Act 2012* (see Table 2-1). Table 3-3 lists the current and valid environmental credentials that the vessel will have in place.

Using Beach's Invasive Marine Species (IMS) Management Plan (CDN/IN S4000AH719916), the CSV will be subject to a risk assessment to ensure that it has a low risk of introducing IMS to the activity area. This process takes into account a vessel's hull anti-fouling paint status, hull fouling condition and recent ports of visitation.

Table 3-3: Key vessel environmental certifications

Certificate	Complies with
International Oil Pollution Prevention (IOPP)	MARPOL Annex I, enacted under Marine Orders Part 91 (Marine Pollution Prevention – Oil)
Shipboard Marine Pollution Emergency Plan (SMPEP)	MARPOL Annex I, enacted under AMSA Marine Orders Part 91 (Marine Pollution Prevention – Oil)
International Pollution Prevention (IPP)	MARPOL Annex II, enacted under AMSA Marine Orders Part 93 (Marine Pollution Prevention – Noxious Liquid Substances)
International Sewage Pollution Prevention (ISPP)	MARPOL Annex IV, enacted under AMSA Marine Orders Part 96 (Marine Pollution Prevention – Sewage)
Garbage Management Plan (GMP)	MARPOL Annex V, enacted under AMSA Marine Orders Part 95 (Marine Pollution Prevention – Garbage)
International Air Pollution Prevention (IAPP), Engine International Air Pollution Prevention (EIAPP), International Energy Efficiency (IEE), Ship Energy Efficiency Management Plan (SEEMP)	MARPOL Annex VI, enacted under AMSA Marine Orders Part 97 (Marine Pollution Prevention – Air Pollution)
International Anti-fouling System certificate	International Convention on the Control of Harmful Anti-fouling Systems on Ships 2008, enacted under AMSA Marine Orders Part 98 (Marine Pollution Prevention – Anti-fouling Systems)

3.5.2 Regulatory Jurisdiction

The vessel comes under the regulatory jurisdiction of AMSA under the *Navigation Act 2012* when it is in Commonwealth waters or the Exclusive Economic Zone (EEZ) of Australia. The CSV is considered part of a 'petroleum activity' (as defined by Regulation 4 of the OPGGS(E)) while it is within the activity area. For the purposes of this EP, activities performed by the CSV when it is outside the activity area (e.g., steaming to or from location) are not covered by the OPGGS(E) and are therefore not addressed in this EP.

While the CSV is located within the activity area, any hydrocarbon spills to sea will be combated in accordance with its SMPEP and in accordance with the oil spill arrangements outlined in the Beach OPEP (CDN/ID S4100AH717907).

3.5.3 Maritime Safety

The CSV will operate in accordance with the Convention on the International Regulations for Preventing Collisions at Sea (COLREG) 1972. The CSV operator will issue a vessel positioning notification to the Australian Hydrographic Office (AHO), who will in turn publish the activity location in the Notices to Mariners (NTM). A daily AusCoast warning of the CSV's location will also be issued to all vessels by AMSA through automatic tracking of the vessel on the Automatic Identification System (AIS). The NTM and AusCoast warnings will provide details of the safe distance to be maintained around the CSV (this is generally 2 nm).

The Master and Officer of the Watch of the CSV are responsible for maintaining control of the vessel operations and for establishing and maintaining communication with third-party vessels and marine traffic during the activity. The CSV will communicate with other vessels using the maritime very high frequency (VHF) working channels (typically monitoring Channel 16 and working on Channel 74). Support vessels associated with the routine operations of the Thylacine platform will have no need to interact with the CSV.

3.5.3.1 Lighting

The lighting on the CSV will comply with COLREG 1972. During the installation process, the vessel will display navigation lights indicating the 'restricted ability to manoeuvre.' In addition to the mandatory navigation lighting, the working deck areas will be lit as required to provide for safe work.

3.5.3.2 Bad Weather Shelter

In cases where extreme weather makes it unsafe for the CSV to remain on location, the vessel Master will either move the vessel leeward of King Island, turn into the weather and head into the seas or return to port.

3.5.3.3 Helicopter Support

Given the planned duration of the activity, there is no expected requirement for helicopter support. If required, it will be conducted from a suitable helicopter base located onshore (e.g., Port Campbell, Warrnambool, Portland). In the unlikely event that emergency medical evacuation may be required, this will be provided by Air Ambulance Victoria. Given the short distance between helicopter shore bases and the activity location, refuelling on the CSV would not be necessary.

3.6 Installation and Commissioning Program

The *Skandi Acergy* will be used to undertake the installation of the subsea infrastructure. The activity is planned to be undertaken over two trips. The *Skandi Acergy* will transit to port (nominally Portland) for interim mobilisations where the completed rigid spools (following final post-metrology fabrication) will be loaded on to the CSV along with other equipment and tools required to complete the remaining work. The CSV will then mobilise back to the activity area to complete the installation and commissioning. Installation activities will include:

- Pre-installation survey.
- Deployment of subsea structures including:
    - TN-1 Manifold.
    - TN-2 FLET.
    - TW FLEM.
    - Dropped object protection frames.
- Rigid spool metrology between newly installed structures and XTs.

- Pre-lay survey and installation of flexible umbilicals including:
  - TN-1 EHU (3,974 m).
  - TW EHU (4,356 m).
  - TN-2 EHU (1,684 m).
  - TA EHU (391 m) including J-tube pull-in.
  - Installation of pre-lay span rectification (if any).
- Installation and back seal testing of flexible flowlines including:
  - 10" TN-1 PFL (3-off separate lengths totalling 4,177 m).
  - 6" TN-2 PFL (single 1,515 m length).
  - 8" TW PFL flowline (2-off separate lengths totalling 4,154 m).
- Installation of MEG Jumper and Flying Leads, including stabilisation (for EFLs).
- Installation of 4-off rigid spools (including back seal testing and WGFM EFLs).
- Pre-commissioning / leak testing of production and MEG systems.
- Installation of EHU and PFL concrete mattresses.
- Installation of dropped object protection.
- Final as-built surveys of remaining installed equipment.
- Cold commissioning support (if required).

3.6.1 Pre-Commissioning Fluids

The fluids and chemicals used for this activity are presented in Table 3-4 along with the components which will be pre-filled with fluids (Table 3-5). References to "% MEG/water solution" refer to the percentage of MEG by weight in a mixture of treated MEG and treated potable water. All chemicals will comply with Beach's Chemical Management Plan (see Section 8.11.1.2).

Table 3-4: Pre-commissioning Fluids

Fluid	Chemical Additive	Comments
Treated Potable Water	Oxygen Scavenger	Hydrosure HD/5000 at 500 ppm from ChampionX or O-3670R
	Biocide	Hydrosure HD/5000 at 500 ppm from ChampionX or Hydrosure O-3670R
	Corrosion inhibitor	Hydrosure HD/5000 at 500 ppm from ChampionX or O-3670R
	Tracer Dye	Hydrosure Red Dye Liquid at 200 ppm from ChampionX. Substitute Red tracer Dye can be proposed subject to BEL endorsement.
MEG	Corrosion inhibitor	Hydrosure HD/5000 at 500 ppm from ChampionX or O-3670R
	Tracer Dye	Hydrosure Red Dye Liquid at 200 ppm from ChampionX. Substitute Red tracer Dye can be proposed subject to BEL endorsement
Oceanic HW 443	Not normally required	Control fluid is formulated to provide corrosion protection and resistance to microbial growth.

Table 3-5: Pre-fill Requirements

Component	Sub-component	Fluid
Subsea Structures	Piping	80% MEG solution
Flexible Flowline	-	40% MEG solution
Rigid Jumpers	-	None
Umbilicals	MEG cores	80% MEG solution
	Methanol cores	
	Spare #2 cores	
	Pressure balance cores	
	Hydraulic cores	MacDermid Oceanic HW443
	Scale Inhibitor / Spare #1 cores	
Flying Leads	MEG cores	80% MEG solution
	Methanol cores	
	Spare #2 cores	
	Pressure balance cores	
	Hydraulic cores	MacDermid Oceanic HW443
	Scale Inhibitor / Spare #1 cores	

3.6.2 Subsea Structure Installation and Metrology

The ROV's will be deployed and conduct a pre-installation survey The subsea structures (TN-1 Manifold, TN-2 FLET and TW FLEM) will be deployed from the CSV utilising its 400T AHC. Prior to land out on the seabed, ROV(s) will control the heading of the structures, either via basic grabs or docking directly to structure, confirming both position and heading are within tolerance before land out and disconnection of rigging. Due to uncertainties in seabed conditions, grouting may be required to stabilise the structures. Scour protection may also be required; this may be undertaken as grout bags, concrete mats or rock dumping.

Following land out of the structures, the ROV(s) will set up at a suitable position on the seabed between the structures and their relevant XTs to complete metrology utilising a Light Detection and Ranging (LiDAR) system. Marker buoys and LIDAR frames may be temporarily landed on the seabed to assist. The metrology data will be sent back to the onshore fabricator so that final dimensions for rigid spools can be determined.

The subsea structures will be installed pre-filled with an 80% MEG/water solution (see Section 3.6.1).

3.6.3 EHU Installations

On completion of the structure installation and metrology, the ROVs will complete pre-lay visual surveys of the EHU and PFL routes. The ROVs will be used to place mudmats to support the Umbilical Termination Assemblies (UTAs) where they connect to the subsea structures. The EHUs will then be installed from the CSV carousel via a horizontal lay system on board the CSV.

The CSV will step along the lay route while the ROVs ensure both EHU positions and lay back distances to the chute exit are within tolerance. The ROVs will adjust the lay as required, to ensure accurate positioning of the second ends to allow land out onto pre-installed mudmats. The ROVs will then secure the UTAs via the mudmat locking mechanism.

The TW EHU will be temporarily laid down such that crossing arrangement can be installed following TN-1 PFL installation then recovered and re-positioned for tie-in to SDU. Concrete mats will be installed for crossings.

The umbilicals will be installed pre-filled with an 80% MEG/water solution (see Section 3.6.1).

3.6.4 Flying Lead and MEG Jumper Installations

Following the EHU installations, the HFLs and EFLs at each well centre will be installed utilising the Flying Lead Deployment Frames (FLDFs) they have previously been packed onto. The MEG jumper will also be installed utilising a FLDF. ROVs will assist with the installations. Flying leads will require stabilisation which are likely to consist of 40 kg grout saddle bags at a spacing of approximately 3-5 m.

3.6.5 TA EHU Pull-In and Installation

The ROV(s) and CSV will then complete a pre-lay survey for the installation of the TA EHU. The EHU will be installed from the CSV carousel. A pull-in winch, located on the TA platform, will be used to pull the EHU pull head through the J-tube to the platform topsides hang off arrangement. Towards the completion of the pull-in a plug/centraliser arrangement will engage at the J-tube bell mouth. The CSV will then complete the lay of the TA EHU followed by the lay of the TN-1, TN-2 and TW EHUs.

Lubrication may be applied to TA EHU to aid in the pull-in operations. Heavy duty Liquid Lanolin[1] would be the proposed lubricant and this would be applied to the TA EHU on deck prior to overboarding.

3.6.6 PFL Installations

Following the EHU installations, the PFLs will be installed from the CSV carousel. The installation of PFLs will include on deck operations to install diver-less connectors at both ends as well as those for the midline connections required for TN-1 and TW PFLs if not already completed beforehand. ROVs will assist with installation on the seabed.

The PFL first end is assembled on deck including a diver-less connector and bend restrictor and filled with a MEG/water mix. A Back Seal Test (BST) is completed. Following assembly, the first end is lowered to depth and landed out with the CSV crane. Pending further assessment, the diver-less connector may be fully assembled by the ROV prior to further lay (vertical gooseneck) or the lay continued with the CSV later returning to assemble the connection (horizontal). Clump weights will be used for initiation.

The second end of PFL will initially be overboarded without the diver-less connector in place (given its size and handling limits), then transferred to the aft of the CSV where the vertical gooseneck is installed, and a BST completed. The CSV crane will then land out the PFL second end at the subsea structures. On completion of tie-in, the ROV will complete a BST to confirm proper assembly.

The new flexible flowlines will be pre-filled with a 40% MEG/water solution (see Section 3.6.1). When the caps are removed during tie-in an estimated 1 m^3 of the of the contents will be released to the marine environment. Chemical sticks (biocide and oxygen scavenger) may be added to the flexible flowline subsea connections. If these are used, then there will likely be some loss (< 150 L) of MEG/water solution.

3.6.7 Rigid Spool Installations and Flushing

The rigid spools will be deployed from the CSV using a lifting spreader. The spools may be partially prefilled with an 80% MEG/water solution (see Section 3.6.1) prior to deployment with the remaining spool volume free flooding during deployment to depth. The ROVs will deploy solid delayed dispersal inhibitor sticks into the manifold bores

[1] All chemicals will comply with Beach's Chemical Management Plan (see Section 3.6.1).

prior to land out and then assist with landout and tie-in at the seabed. A Back Seal Test (BST) of each connector will be performed to confirm proper assembly. Approximately 380 L of the 80% MEG/water solution may be lost to the environment during the BST.

3.6.8 Pre-Commissioning/Leak Test

Following the rigid spool installations, the CSV will relocate to the nominated leak test connection point. Utilising a downline to connect test pumps located on the CSV's deck, pre-commissioning operations will be completed, first for the production system and then the MEG system. It is possible that some loss of MEG/Water or control fluid may occur during the leak test (< 500 L).

3.6.9 Mattress Installation & Free-Span Correction

Concrete mattresses and free span rectification support may be required. Free span rectification may consist of mattresses or grout bags, depending on the free-span.

3.6.10 As Built Survey

The CSV will complete the visual/position as-left surveys utilising the ROVs and additional survey equipment.

3.6.11 Cold Commissioning Support

Following completion of the installation operations, including as-built survey, the CSV will also complete cold commissioning operations under instruction from Beach. This would likely include ROV visual surveys and valve manipulations.

3.7 Operations, Inspection and Maintenance

Once installed, the Thylacine subsea equipment becomes part of the Otway offshore operations. This will be from when the field isolations have been removed and hydrocarbons are introduced to the existing infrastructure. The equipment that forms part of this EP will be added to Beach's Computerised Maintenance Management System (CMMS) to facilitate inspection and maintenance of the equipment to ensure it remains in good condition and repair and to facilitate future removal and decommissioning. This meets the requirements of the OPGGS Act subsection 572(2). The Otway Offshore Operations EP will also detail the requirements to meet OPGGS Act 572(3) to remove all structures when they are no longer used.

The operation, inspection and maintenance of the subsea equipment described in this EP (along with the wells described in the Otway Offshore Operations EP) will be incorporated into the Otway Offshore Operations EP. To avoid doubt, the equipment installed under this EP will be covered by this EP until the revised Otway Offshore Operations EP has been accepted as complete for assessment by NOPSEMA.

3.8 Decommissioning

One of the final petroleum activities managed under the OPGGS(E) for a petroleum title is decommissioning. Under subsection 270(3) of the OPGGS Act, before a title can be relinquished, all property brought into a title area must be removed or arrangements that are satisfactory to NOPSEMA must be made in relation to the property. 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. There may also be requirements under the *Environmental Protection (Sea Dumping) Act 1981* that apply to some decommissioning activities.

Beach acknowledges that the default position in 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 the legislation and NOPSEMA policy into a future Otway offshore decommissioning concept study.

While Beach has not yet made plans for decommissioning, the property and equipment to be installed during this activity has been designed for full removal. The equipment installed as part of this activity will be recorded (Section 3.6.10) and as discussed in Section 3.7 become part of the Otway Offshore Operations EP.

An as-built ROV survey of the subsea equipment will be undertaken to accurately define the position and final status of the equipment. This survey will also identify whether any dropped objects or temporary installation aids remain so that they can either be removed at the time of the survey or added to the assets register for later removal to comply with OPGGS Act Section 572.

3.8.1 Decommissioning Process

The process for decommissioning offshore Otway infrastructure is described in Section 5.23 of the NOPSEMA-accepted Otway Offshore Operations EP (Rev 7, Aug 2017).

Decommissioning is covered by Beach's Operations Excellence Management System (OEMS) Element 6. The suspension of assets is divided into:

- Temporary suspension;
- Mothballing;
- Preliminary abandonment; and
- Final abandonment and removal.

The requirement to initiate preliminary or final abandonment for assets of the scale of the Otway 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.

Beach applies its 'gate process' to decommissioning projects, as illustrated in Figure 3-5.

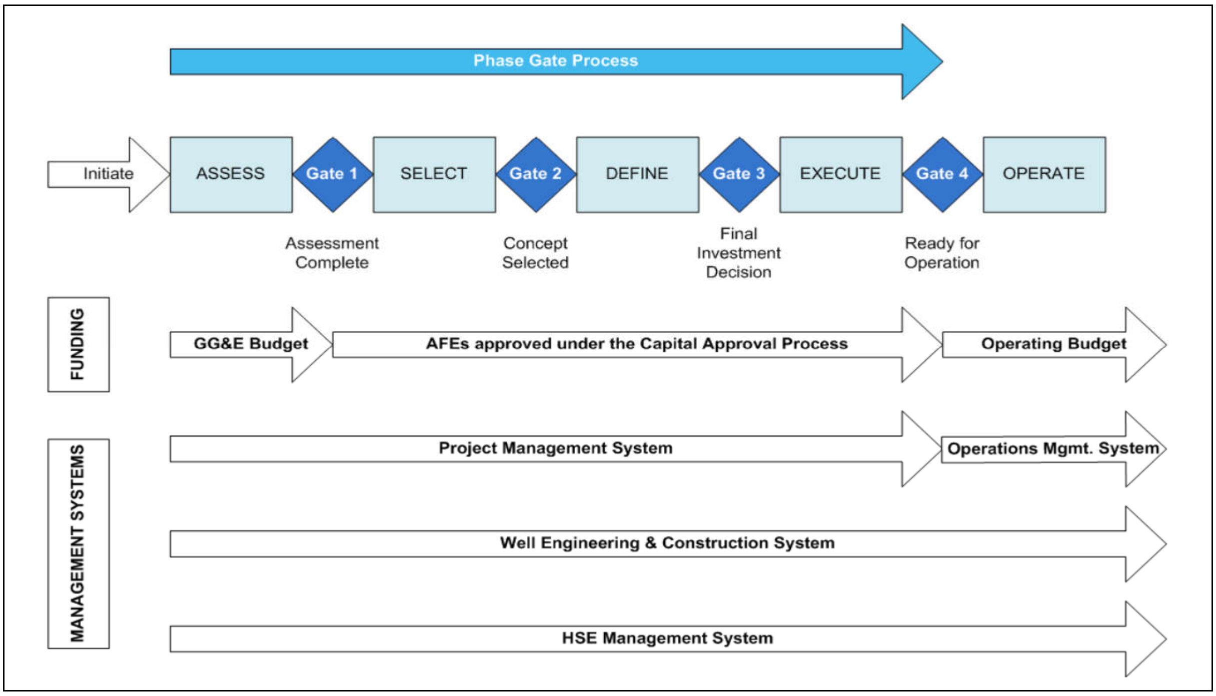


Figure 3-5: Beach's gate process

The proposed decommissioning strategy is (as per Figure 3-5):

- 'Assess' decommissioning options – Cessation of Production (CoP) minus 3 years;
- 'Select' decommissioning option – CoP minus 2 years;
- Commence COP regulatory approvals process – CoP minus 2 years;
- Obtain regulatory approvals – CoP minus 6 months;
- Cease production;
- Commence decommissioning regulatory approval process – CoP plus 6 months;
- 'Define' decommissioning plans;
- Obtain decommissioning regulatory approvals – CoP plus 18 months; and
- 'Execute' decommissioning activities.

Until a decommissioning process commences, no timeframe can be allocated to this process, though this would be expected to take several years from the 'assess' phase through to the 'execute' phase. Decommissioning plans for a particular asset will be prepared in accordance with Section 4.6.5.5 of Beach's OEMS Summary Manual.

3.8.2 Decommissioning Environmental Approvals

Condition 5 of the EPBC Act approval for the Otway Gas Development (2002/621) requires that a decommissioning plan be approved by the Minister prior to decommissioning of any components of the floating production, subsea wells, flowlines or any associated infrastructure. The plan must consider the complete removal of all structures and components above the sea floor, decommissioning may not commence until the plan is approved and the approved plan must be implemented.

During the decommissioning planning stage, Beach will prepare plans for cessation of production (CoP) of the Otway gas fields and associated infrastructure under production licence requirements. An EP for CoP will be prepared and submitted to NOPSEMA prior to CoP, which will be followed by a decommissioning EP. The CoP EP will include any proposed alternative arrangements to complete removal of property at the CoP in alignment with the NOPSEMA Policy *Section 572 Maintenance and removal of property regulatory policy*. The Department of Industry, Science and Resources (DISR) *Offshore Petroleum Decommissioning Guideline* (January 2018) and the NOPSEMA *Decommissioning Compliance Strategy* (April 2021) (and any future revisions of these documents) will be taken into account during the decommissioning planning process. Issues likely to be explored in the decommissioning EP (and addressed through the stakeholder consultation process) include:

- Decommissioning options (plug and abandon wells and remove XTs, leave platform, pipeline, subsea structures, umbilicals and flowlines 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 requirement in Commonwealth waters for decommissioned platforms is 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 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.

Table 3.4. Environmental performance requirements for decommissioning

EPO	EPS	Measurement criteria
Once the CoP phase is complete, works are undertaken that allow the seabed of the activity area to return to a pre-disturbance state.	A net environmental benefit analysis (NEBA) will be undertaken to determine the optimal environmental and social solutions to decommissioning subsea property and equipment.	NEBA report verifies assessment was undertaken.
	Decommissioning is undertaken in accordance with OPGGS Act Section 572 and an accepted EP.	EP and letter of acceptance are available.
		ROV survey footage (and photos of recovered equipment, as appropriate) and associated report verifies that subsea property and equipment is managed as per the accepted decommissioning EP.

4 Stakeholder Consultation

4.1 Otway Offshore Project

This activity is part of Beach's Otway Offshore Project. Activities for the Otway Offshore Project have run over several phases beginning with seabed assessments, and then drilling exploration and production wells in the Geographe and Thylacine gas fields, and installation of seabed infrastructure to support tie-in of the wells to the existing Thylacine A Platform (TA) and pipeline.

The current phase (Phase 5) includes the tying in of four new wells in the Thylacine field to the TA and the commissioning of these wells. All activities will occur within permit T/L2 and T/L4. A detailed description of the activity is provided in Chapter 3.

Stakeholder consultation for this activity has been captured in the broader consultation efforts for the Otway Offshore Project. This consultation has been ongoing since 2019 and will continue as required. 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.

An overview of the Otway Offshore Project and regularly updated Information Sheets are available on Beach's website. These Information Sheets have been emailed to stakeholders, along with additional information, throughout the course of the Beach's consultation.

Information regarding consultation objectives, methodology and outcomes for this activity can therefore be found in the following accepted EPs:

- Otway Offshore Operations EP (CDN/ID 17275058) – Chapter 9;
- Artisan Exploration Drilling EP (CDN/ID S4810AH717904) – Chapter 9;
- Otway Development Drilling and Well Abandonment EP (CDN/ID S4100AH717905) – Chapter 9;
- Trefoil Geophysical and Geotechnical Seabed Survey EP (S4200AH718461) – Chapter 9;
- Otway Phase 5 Early Dive Installation Campaign EP (CDN/ID S4130AF725242) – Chapter 9.

These EPs, along with all of the Beach's accepted EPs, can be viewed on the NOPSEMA website.

4.2 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.

Regulation 11A of the OPGGS(E)R 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.

Regulation 16(b) of the OPGGS(E)R requires that the EP contain a report on all consultations under regulation 11A of any relevant person by the titleholder, that contains:

i. a summary of each response made by a relevant person; and

ii. an assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates; and

iii. a statement of the titleholder's response, or proposed response, if any, to each objection or claim; and

iv. a copy of the full text of any response by a relevant person.

A copy of the full text of any response by a relevant person in consultation under regulation 11A in the course of preparing the plan has been provided to NOPSEMA as a Sensitive Information Appendix under Regulation 9(8) of the OPGGS(E)R.

4.3 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.

4.4 Consultation Approach

The approach Beach has undertaken for consultation for the 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.

4.5 Fisheries Specific Consultation

Beach has identified that the main stakeholder group for the activity is commercial fishers. The consultation strategy for potentially impacted fishers is as follows:

- request fishing data from VFA, DPIPWE and AFMA to verify fishing effort within designated fisheries in the operational area, in order to seek engagement with relevant fishing associations and commercial fishers.
- provide an updated information sheet to SETFIA and SIV for distribution to their members as applicable.
- provide an updated information sheet to other relevant fishery associations and individual fishers where known.
- provide additional information to interested fishery groups where requested. Beach provided information to fishery groups and to date has not had any response from fishers.

- where fishers have identified that they may be potentially impacted by the activity the following is undertaken:
  - for fishers who have contacted SIV (or other fishing associations), Beach liaises with SIV to gather information about the fishers fishing patterns and locations and to establish contact for ongoing consultation throughout the activity.
  - for fishers who have contacted Beach directly, engage with them and gather information about their fishing patterns and locations and to establish contact for ongoing consultation throughout the activity.
  - where fishers are providing Beach with sensitive fishing data Beach provide them Beach's privacy policy and obligations.
  - Beach offered SMS messaging to commercial fishers and their associations to provide project updates before, during and after the activity. Beach provides regular updates on the locations that the vessel will be operating in as well as the expected duration so fishers can plan their fishing activities with the least disruption.
- Beach has a stated position that fishers should not suffer an economic loss as a result of our activities. Beach's *Fair Ocean Access – Procedure for Compensation Claims from Commercial Fishers* is explained in clear and simple language in the *Fair Ocean Access information sheet* (Appendix A). It summarises Beach's procedures for minimising and mitigating potential impacts to commercial fishing and procedures for compensation claims from commercial fishers. Beach will ensure that the evidence required is not burdensome on the fisher while ensuring genuine claims are processed.

4.6 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, Lattice and Origin.
- 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, then Lattice and Beach.

Lattice 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 considers that they have effectively identified relevant stakeholders and have a good understanding of issues and areas of concern within the Otway Development area. Table 4-1 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.

Table 4-1: Relevant stakeholders for the activity (refer to Table 4-2 for information category definition)

Stakeholder	Relevance	Information category
Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant		
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 Border Force - Maritime Border Command	Australian Government agency responsible for maritime security	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 (DNP)	Australian Government agency responsible for MNES and Australian Marine Parks	1
DCCEEW – Biosecurity	Australian Government agency responsible for preventing, responding and recovering pests and diseases that threatened the economy and environment.	1
Department of Agriculture, Fisheries and Forestry (DAFF)	Ensuring Australia's agriculture, fisheries, food and forestry industries remain competitive, profitable and sustainable. No impact to stakeholders' functions, interests or activities. Beach maintains engagement in relation to activities within the Otway area.	1
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		
Victorian Fisheries Authority (VFA)	Activity is within a Victorian fishery area or will impact or potentially impact a Victorian fishery area or resource.	1
Transport Safety Victoria - Maritime Safety Victoria	Management of marine safety in Victoria. Relevant in relation to fishers entering PSZ.	1
The Department of the Responsible State or Northern Territory Minister		
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

Stakeholder	Relevance	Information category
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP		
ANZT Fishing Company Pty Ltd	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	1
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: SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors). Southern Squid Jig Fishery.	1
Crab and Shark Fisher	This stakeholder has acknowledged concern in the past during consultation. Beach maintains engagement in relation to activities within the Otway area.	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
Gazak Holdings Pty Ltd	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	1
Lobster fisher	This stakeholder has acknowledged concern in the past during consultation. Beach maintains engagement in relation to activities within the Otway area.	1
Muollo Fishing Pty Ltd	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	1
Petuna Sealord Deepwater Fishing Pty Ltd	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	1
Port Campbell Professional Fisherman's Association	Association representing Port Campbell fishers, primarily rock lobster around Port Campbell and Peterborough. Engagement via SIV.	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: 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

Stakeholder	Relevance	Information category
Southern Rock Lobster Limited South Eastern Professional Fishermen's Association Inc. Tasmanian Rock Lobster Fishermen's Association	Associations representing state-based commercial rock lobster fishers. Associations are represented by one consultancy and are therefore grouped.	1
Sustainable Shark Fishing Inc	Represents shark fishers. Engagement via SIV.	1
Toberfish Pty Ltd.	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	1
Trinsand Fisheries	This stakeholder fishes in the region. Beach maintains engagement in relation to activities within the Otway area.	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
Any other person or organisation that the titleholder considers relevant		
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 maintains 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 maintains engagement in relation to activities within the Otway area.	3
Atlantis Fisheries Consulting Group	Provide expert research advice and consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia. Beach provides information as have ongoing engagement in relation to marine studies within their operating areas. No impact to stakeholders' functions, interests or activities.	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 maintains 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 maintains 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 maintains engagement in relation to activities within the Otway area.	3
Corporate Alliance Enterprise	Provide expert research advice and consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia. Beach provides 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
Deakin University – School of Life and Environmental Sciences (Deakin)	Beach provides information as they have ongoing engagement in relation to marine studies within their operating areas. No impact to stakeholders' functions, interests or activities.	3
Eastern Maar Aboriginal Corporation (EMAC)	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintains engagement in relation to activities within the Otway area.	1
First Nations Legal & Research Services Ltd	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintains 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 provides 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 provides information as have ongoing engagement in relation to seismic survey impacts to commercial fisheries.	3
King Island Council	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintains engagement in relation to activities within the Otway area.	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 sends 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 (OGPCRG)	Community Reference Group established for the Otway Gas Plant. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintains 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 maintains 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 maintains 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 maintains engagement in relation to activities within the Otway area.	3

Stakeholder	Relevance	Information category
SCUBA Divers Federation of Victoria	No impact to stakeholders' functions, interests or activities, because of the distance offshore. However, Beach maintains engagement in relation to activities within the Otway area.	3
Surf Coast Council	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintains engagement in relation to activities within the Otway area.	3
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 maintains 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 maintains 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 maintains 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 maintains 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 maintains engagement in relation to activities within the Otway area.	3
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 maintains 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 maintains engagement in relation to activities within the Otway area.	3
Victorian Recreational Fishing Peak Body	Represents recreational fishers. No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintains 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 maintains engagement in relation to activities within the Otway area.	3

4.7 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 4-2.

Table 4-2: Information category to determine information provided to relevant persons

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
2	Organisation who receives 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

All of the relevant persons identified in Table 4-1 were sent emails with project updates on the following dates:

- 1st October 2021.
- 1st November 2021.
- 4th November 2021.
- 12th November 2021.
- 21st December 2021.
- 14th January 2022.
- 28th February 2022.
- 11th April 2022.
- 7th July 2022.

Copies of these emails (and responses from stakeholders) have been provided to NOPSEMA as a Sensitive Information Appendix under Regulation 9(8) of the OPGGS(E)R. Note that many of the stakeholders did not respond to these emails.

4.8 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. Table 4-3 outlines the ongoing consultation (and timing) requirements for the activity. Records of ongoing stakeholder engagement are maintained as per Section 8.4.3.

Any new relevant persons, or changes to existing relevant persons, will be identified through ongoing consultation with stakeholders (including peak industry bodies), through the environment plan review process (Section 8.12.1.3) and in accordance with Section 4.6. 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 4.9.

4.9 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 6 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 8.12.1.3. This will also be communicated to the stakeholder.

4.10 Summary of Stakeholder Consultation

Table 4-4 provides a summary of the stakeholder consultation undertaken between 31st July 2021 and 24th August 2022. 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. Consultation undertaken prior to this time has been reported in other EPs prepared for the Otway Offshore Project (see Section 4.1). These EPs, along with all of the Beach's accepted EPs, can be viewed on the NOPSEMA website.

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. 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 Chapter 6 and controls applied where appropriate to ensure impacts and risks are managed to ALARP and an acceptable level.

Copies of the full text of any response by a relevant person have been provided to NOPSEMA as a Sensitive Information Appendix under Regulation 9(8) of the OPGGS(E)R.

Table 4-3: Ongoing stakeholder consultation requirements

Stakeholder	Ongoing stakeholder requirement	Timing
Relevant stakeholders	Ongoing engagement including: stakeholder communication of information and addressing queries and concerns via email, phone or meeting; and updates to Beach website.	As required
Relevant stakeholders listed in Table 4-2 under category 1	Stakeholder notification of activity commencement, including: type of activity; location of activity, coordinates and map; timing of activity: expected start and finish date and duration; sequencing of locations if applicable; vessel details including call sign and contact; any safety exclusion zones required; and Beach contact details. Note: coordinates to be provided as degrees and decimal minutes referenced to the WGS 84 datum.	2 weeks prior to activity commencing
AHO	Vessel Contractor to issue notification of activity for publication of notice to mariners, including: 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. Update AHO of progress, changes to the intended operations including if activity start or finish date changes.	4 weeks prior to activity commencing
AMSA - JRCC	Vessel Contractor to issue notification of activity for promulgation of radio navigation warnings, including: type of activity; area of operation: geographical coordinates of the well location; any exclusion zones required; period that warning will cover (start and finish date);	48 – 24 hrs prior to activity commencing

Stakeholder	Ongoing stakeholder requirement	Timing
	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. Update AMSA JRCC of progress, changes to the intended operations including if activity start or finish date changes.	
NOPSEMA	Regulatory notification of start of activity.	10 days prior to activity commencing
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 4-4: Summary of stakeholder consultation records and Beach's assessment of objections and claims

Stakeholder	Date	Record #	Description	Assessment of objection or claim
Australian Border Force - Maritime Border Command	20/08/2021	ABF-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	No concerns raised
Australian Fisheries Management Authority	20/08/2021	AFMA-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	See AFMA-02
	2/09/2021	AFMA-02	AFMA advising that it is important Beach consult with all fishers in proposed area.	Beach confirmed they have been consulting with all fishers in proposed area for the last few years. Noted that change to the petroleum title does not affect our activities as previously advised to fishing associations. We will continue to advise relevant fishing associations and fishers as we've been doing. No further action
Australian Maritime Safety Authority	20/08/2021	AMSA-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	No concerns raised
	15/11/2021	AMSA-02	Acknowledged the project update and appreciated regular updates of Beach's operations.	No concerns raised
	1/03/2022	AMSA-03	Appreciation of communication.	No concerns raised
	11/04/2022	AMSA-04	Appreciation of communication.	No concerns raised
	7/07/2022	AMSA-05	Appreciation of communication.	No concerns raised
Department of Defence - Australian Hydrographic Office	20/08/2021	AHO-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	No concerns raised
	26/04/2022	AHO-02	Query regarding if the rig move is still on track.	No concerns raised
	11/07/2022	AHO-03	Request for maps of Geographe 2, 4 and 5 and Thylacine North 1 and 2, Thylacine West 1 and 2, so they can be added to the navigation charts.	No concerns raised
	18/07/2022	AHO-04	Advised the email had been passed on internally and someone will respond.	No concerns raised
Director of National Parks	20/08/2021	DNP-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	in progress
	7/10/2021	DNP-02	Acknowledged email.	in progress
	28/10/2021	DNP-03	Confirmed notification requirements in the event of a spill.	in progress
	2/11/2021	DNP-04	Acknowledgement of email received.	No concerns raised
	23/12/2021	DNP-05	Receipt of email.	EP consistent with these requirements
	19/01/2022	DNP-06	Acknowledgement of email received.	No concerns raised
	4/03/2022	DNP-07	Appreciation of the email and update.	No concerns raised
Transport Safety Victoria - Maritime Safety Victoria	28/03/2022	TSV-01	Beach provided information on recreational fishers inside the PSZ. Requested TSV notifies the owners of these recreational vessels to alert them to the significant safety risks associated with entering a PSZ.	see below
	28/03/2022	TSV-02	Further discussion and action around the breach in PSZ.	see below
	29/03/2022	TSV-03	Beach provided information on additional recreational fishers inside the PSZ.	see below
	31/03/2022	TSV-04	Beach advised that a public notice would be in the Warrnambool Standard re PSZ	see below
	1/04/2022	TSV-05	Further discussion re fishing boats too close to Beach operations.	TSV contacted boat owners. Beach placed public ad.
Department of Natural Resources and Environment Tasmania - Conservation	3/03/2022	DNRE-01	Thanks for the update, I have saved to our files.	No concerns raised
	12/04/2022	DNRE-02	Appreciate the update.	No concerns raised
	8/07/2022	DNRE-03	Thanks for sending through the update.	No concerns raised

Stakeholder	Date	Record #	Description	Assessment of objection or claim
Lobster fisher	6/09/2021	LF-01	Advising of outcome of previous compensation claim assessment.	Issue resolved
	19/04/2022	LF-02	Response to phone call in relation to two vessels travelling through fishing grounds. Beach advised that they are investigating the incident and have reminded their vessel contractors of instructions to not travel through fishing grounds. Asked for confirmation of areas which should be avoided. Supplied project update, including vessel contact details, and advised contacting the vessels directly; if you don't get a reasonable response, please contact Beach. Advised the other vessel was not contracted Beach - provided contact details for vessel's client.	Investigation launched
	20/04/2022	LF-03	Further discussion around lost fishing gear.	Investigation
	22/04/2022	LF-04	Advising of outcome of investigation. Provided vessel traffic data showing Beach's contracted vessels had followed agreed routes. Offered further consultation.	Issue resolved
Portland Professional Fishermen's Association	4/11/2021	PPFA-01	Asked that if our vessels are using the Port of Portland, that they abide by the attached navigation warning.	Information sheet updated
	5/11/2021	PPFA-02	Beach advised that there is no intention for the vessels to travel through to Portland, however the notice has been passed on to them on the off chance they do need to.	No concerns raised
	15/01/2022	PPFA-03	Advised that coordinates to the fishing sector would be best expressed in Degrees and Decimal Minutes to 3 places.	No concerns raised
	31/01/2022	PPFA-04	Updated information sheet as requested.	Published 11 April 22
	2/02/2022	PPFA-05	Acknowledgement and appreciation of the updated information sheet.	No concerns raised.
	8/04/2022	PPFA-06	Beach advised that Information Sheet publication delayed.	Ongoing engagement
	11/04/2022	PPFA-07	Acknowledgement and appreciation of the updated information sheet.	Ongoing engagement
Seafood Industry Victoria	3/10/2021	SIV-01	Former SIV employee requested removal from email list	Issue resolved
	4/10/2021	SIV-02	Former SIV employee removed from list.	No concerns raised
	6/07/2022	SIV-03	Meeting to discuss Beach's operations in Otway Basin and Calico survey and interactions with fishers.	No concerns raised
	8/07/2022	SIV-04	Summarised the meeting notes from a discussion regarding Beach's operations in Otway Basin and Calico survey.	No concerns raised
Atlantis Fisheries Consulting Group	2/03/2022	AFC-01	Discussion and approval to send SMS message of project update. Approved and sent.	No concerns raised
Australian Communications and Media Authority	20/08/2021	AMCA-01	Provided notice that Beach intends to apply to NOPTA to convert Beach's adjacent exploration block (T/30P) to a production block.	No concerns raised
Cooper Energy	07/07/2022	CE-01	Congratulations	Ongoing engagement
Eastern Maar Aboriginal Corporation	13/09/2021	EMAC-01	Online meeting including presentation by Beach and discussion on several topics.	Ongoing engagement
	13/09/2021	EMAC-02	Online meeting including presentation by Beach and discussion on several topics.	Ongoing engagement
	17/09/2021	EMAC-03	Follow up email and offers for ongoing engagement	Beach sent the info sheet and link to the website. Beach thanked them for the invite to their meeting. Meeting arranged
First Nations Legal & Research Services Ltd	3/09/2021	FNLR-01	FNLRS reached out to Beach on behalf of EMAC and invited senior Beach representative to attend their upcoming board meeting Sept 13 to talk about all the activity / projects, with enough clarity for EMAC to be able to inform their community. Also requested more information about the projects.	Ongoing engagement
	6/09/2021	FNLR-02	Beach requested further information and offered to make presentation to EMAC on 13 September 2021.	Ongoing engagement
King Island Council	30/07/2021	KIC-01	Beach provided information to KIC about temporary COVID arrangements regarding the operations at King Island aviation base. Information was published in King Island Courier.	Ongoing engagement
Lochard Energy	22/12/2021	LE-01	Query regarding the project update -is link ok to click on? Yes. Also attached the information sheet.	No concerns raised
Surf Coast Council	12/10/2021	SCC-01	Provided a presentation of Projects update including Enterprise Project and Offshore Program.	No concerns raised
	5/11/2021	SCC-02	Acknowledgment of project update and appreciation of being updated and informed on Beach's operations.	No concerns raised
Surf Riders Association	22/12/2021	SRA-01	Confirmed contact emails for organisation.	No concerns raised
	07/07/2022	SRA-02	Contact on leave. Advised of alternative contacts	No concerns raised
Victorian Recreational Fishing Peak Body	4/04/2022	VRF-01	Discussion on recreational fisher's vessels being within the 500 m PSZ. Engagement asking for their support to send out a warning/education piece to its members.	Ongoing engagement

5 Description of the Environment

5.1 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. Many of the planned activities only have the potential to affect the environment within the activity area (e.g., operational discharges, physical presence and seabed disturbance). The EMBAs for other planned activities are based on applicable guidelines (i.e., 20 km EMBA for light emissions – see Section 7.5) or modelling (i.e., 3.65 km for underwater noise – see Section 7.3).

The outer boundary of the EMBA from a worst-case spill of marine diesel oil (MDO) from the CSV during the activity was determined from the combined stochastic results of oil spill trajectory modelling (RPS, 2022) from 100 simulations per season (summer [November to March] and winter [April to October]) and applying the following thresholds:

1 g/m^2 floating oil thickness, which is considered below levels which would cause environmental harm and is more indicative of the areas perceived to be affected due to its visibility on the sea-surface

10 g/m^2 for accumulated (shoreline) oil, which represents the area visibly contacted by the spill

10 ppb for dissolved hydrocarbons corresponds generally with potential for exceedance of water quality triggers

10 ppb entrained hydrocarbons which represents the low exposure zone and corresponds generally with potential for exceedance of water quality triggers.

The hydrocarbon spill EMBA ('spill EMBA' for simplicity) is defined as:

> *The extent of low level hydrocarbon exposure to the sea surface (1 g/m^2), entrained in the water column (10 ppb) and dissolved in the water column (10 ppb) as a result of a release of 603.7 m^3 of MDO (over 6 hours) from the CSV during summer and winter metocean conditions.*

The spill EMBA is further refined by applying the *NOPSEMA Bulletin #1 Oil Spill Modelling* (NOPSEMA, 2019). This bulletin uses hydrocarbon contact values of four oil phases (surface, dissolved, entrained and accumulated shoreline) that pose differing environmental risks to define the outer extent of the EMBA. The low contact values used to inform the extent of the socio-economic EMBA are useful for establishing scientific monitoring parameters and identifying potential socio-economic impacts (the socio-economic EMBA); however, they may not be at concentrations that are ecologically significant (NOPSEMA, 2019). Therefore, in addition to the socio-economic EMBA, an ecological EMBA has also been derived from the stochastic spill modelling using hydrocarbon thresholds that are identified by NOPSEMA (2019) as having the potential to cause impacts to ecological receptors (see Table 5-1).

Figure 5-1 and Figure 5-2 present the socio-economic spill EMBAs for summer and winter, respectively. The Description of the Environment in this Chapter is based on the combined socio-economic spill EMBA for both seasons (Figure 5-3).

Table 5-1: Oil spill thresholds used to define the spill EMBA

Hydrocarbon phase	Exposure values	
	Socio-economic EMBA	**Ecological EMBA**
Shoreline	Low - **10 g/m²** Potential for some socio-economic impact.	Moderate - **100 g/m²** Area likely to cause environmental impacts and to require clean-up effort.
		High - **1,000 g/m²** Area likely to require intensive clean-up effort.
Sea surface (floating)	Low - **1 g/m²** Approximates socio-economic effects and planning area for scientific monitoring.	Moderate - **10 g/m²** Lower limit for harmful contact to birds and marine mammals.
		High - **50 g/m²** Approximates surface oil slick and informs response planning.
Dissolved	Low - **10 ppb** Planning area for scientific monitoring as potential water quality trigger exceedance.	Moderate - **50 ppb** Potential toxic effects, particularly sub-lethal effects to sensitive species.
		High - **400 ppb** Toxic effects, including lethal effects to sensitive species.
Entrained	Low - **10 ppb** Planning area for scientific monitoring as potential water quality trigger exceedance.	High - **100 ppb** To inform risk evaluation.

(NOPSEMA, 2019)

Table 5-2 describes the EMBA zones associated with the activity that are used to describe the environment and to support the impact and risk assessments. The EPBC Act Protected Matters Reports are included as Appendix B.

Table 5-2: Description of EMBA Zones

EMBA Zones	Description
Activity area	The activity area is described in Section 3.1. Planned operational discharges, physical presence and seabed disturbance that occur during the activity will be within the activity area.
Underwater noise	The EMBA for underwater noise is based on the modelling results for behavioural disturbance to low-frequency cetaceans (JASCO 2022). It includes a 3.65 km buffer around the activity area.
Light EMBA	The EMBA for light emissions is based on the *National Light Pollution Guidelines for Wildlife* (Commonwealth of Australia 2020). It includes a 20 km buffer around the activity area.
Spill EMBA	The socio-economic spill EMBA is based on the stochastic results of oil spill trajectory modelling (RPS 2022) as described above and using the NOPSEMA thresholds (Table 5-1). Figure 5-3 shows the combined EMBA for both seasons (summer and winter).

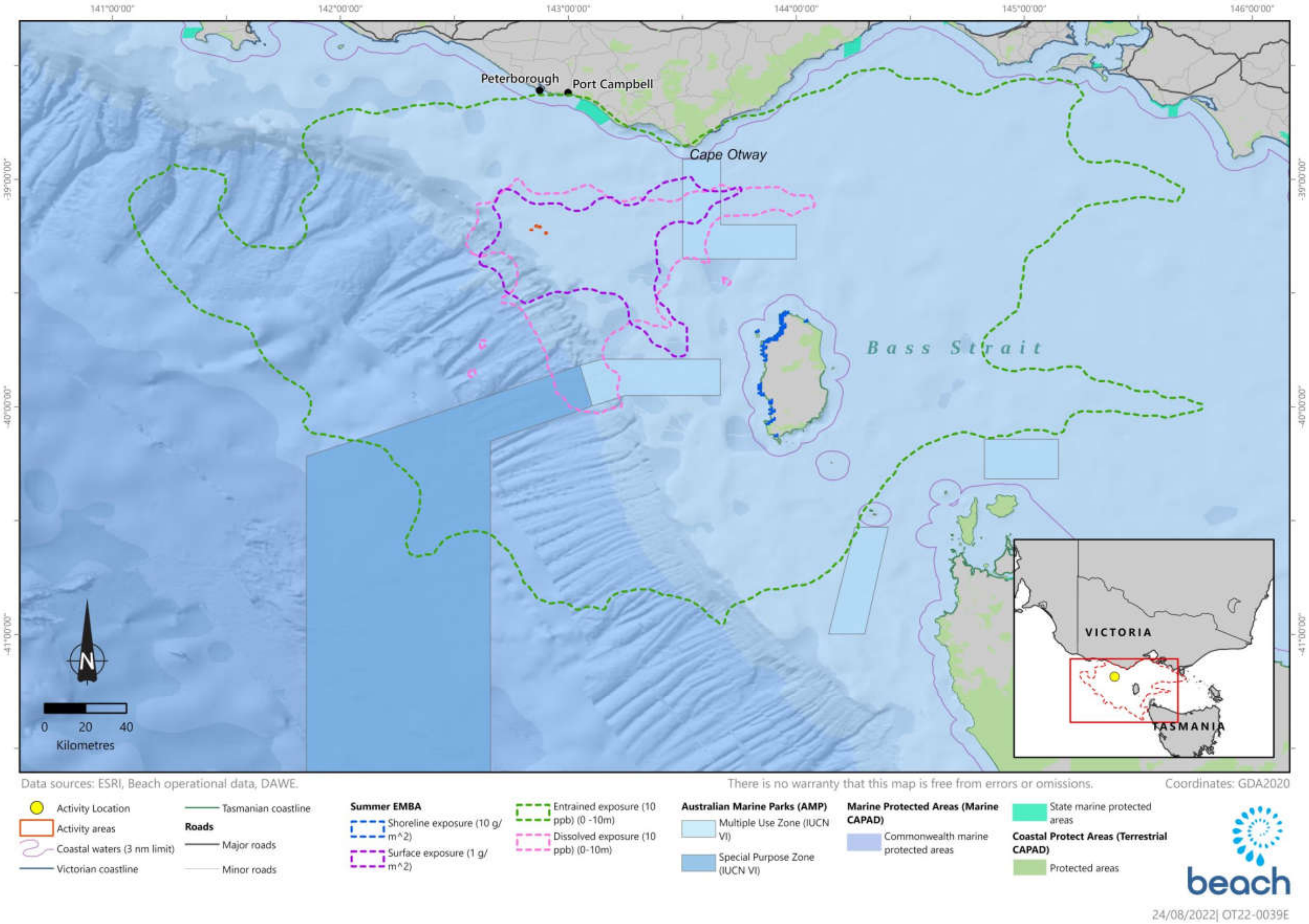


Figure 5-1: Socio-economic spill EMBA for the Summer (November to March) months

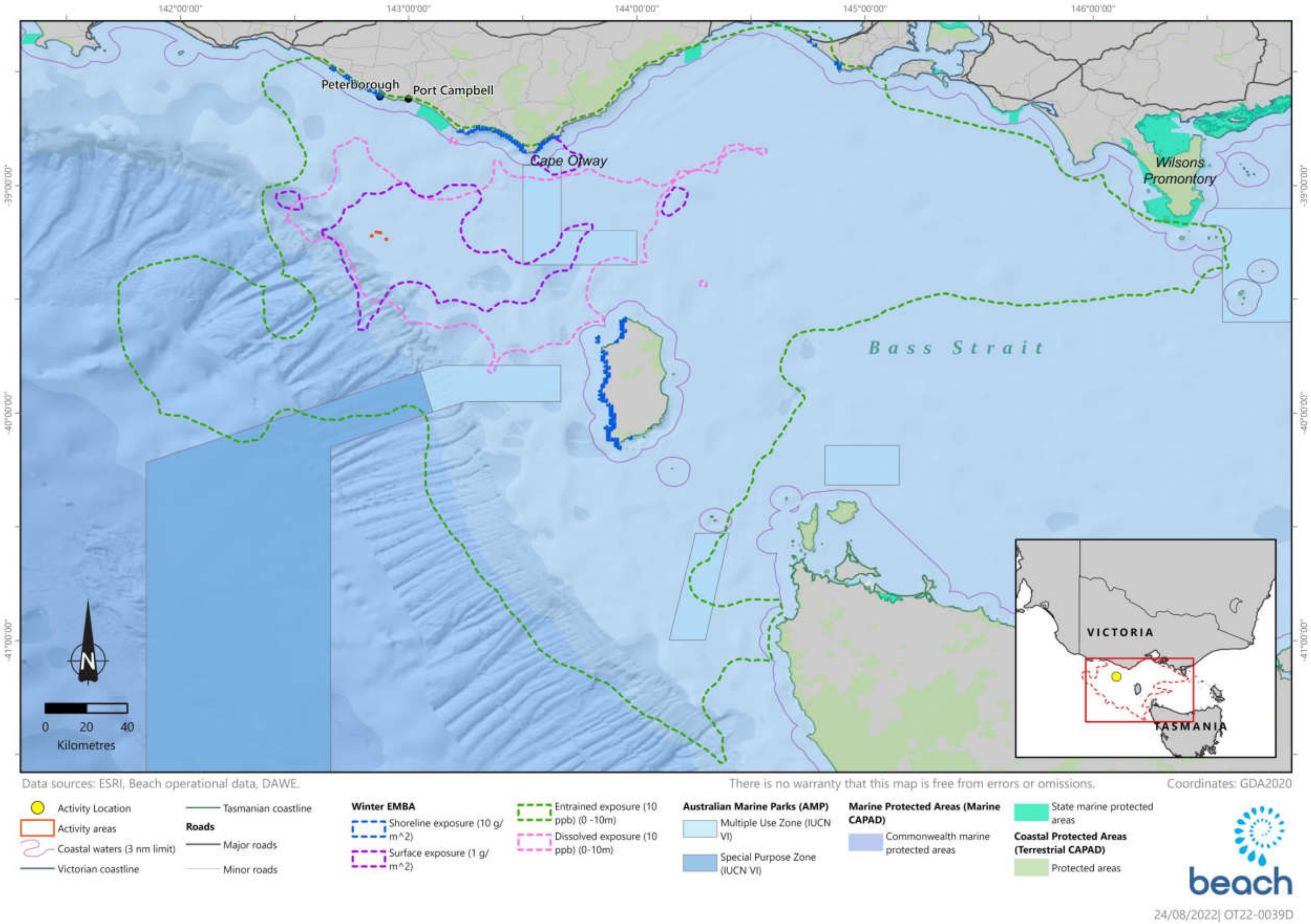


Figure 5-2: Socio-economic spill EMBA for the Winter (April to October) months

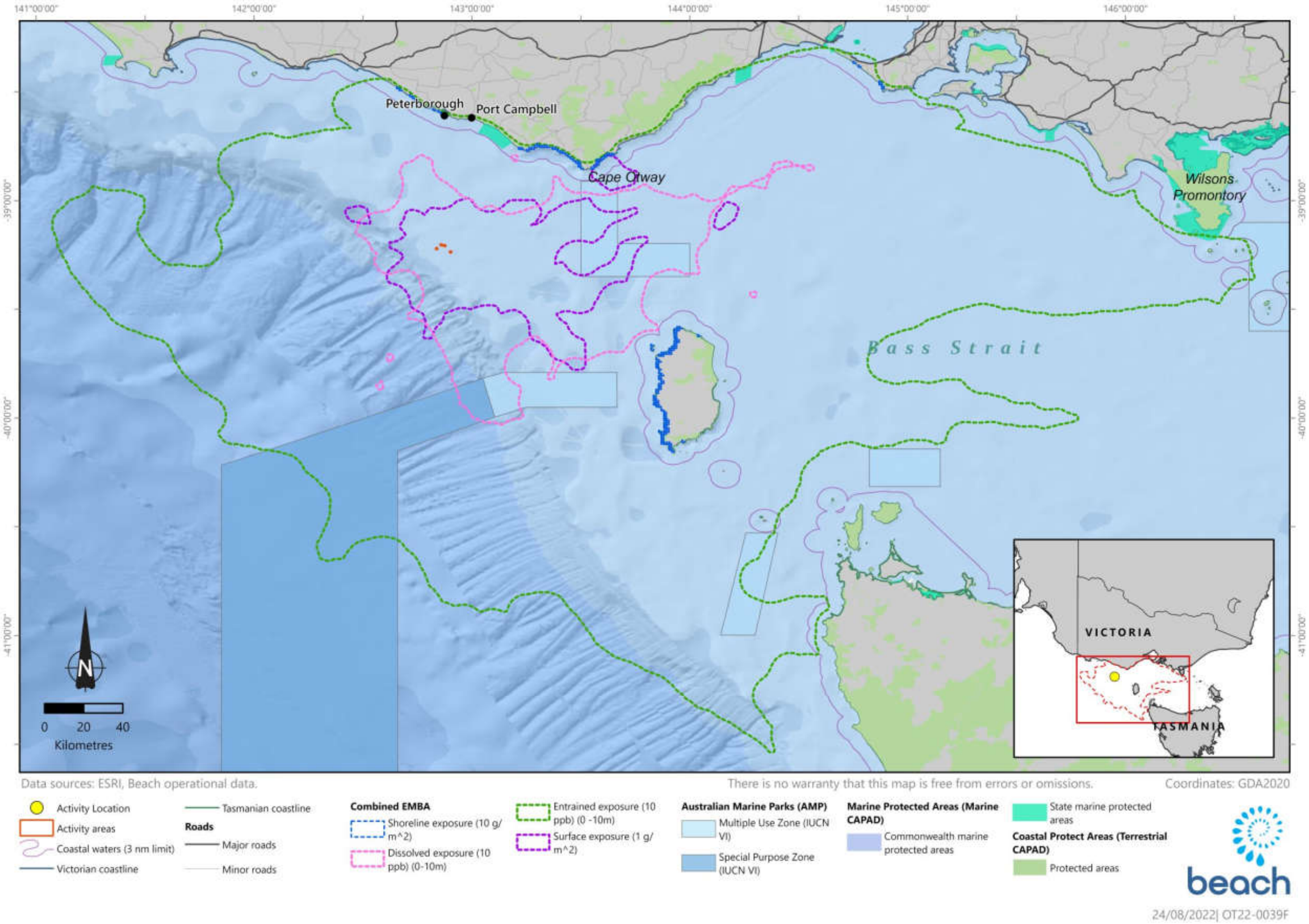


Figure 5-3: Annualised socio-economic spill EMBA for the activity

5.2 Regional Environmental Setting

The activity 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 (Commonwealth of Australia, 2015).

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 (Commonwealth of Australia, 2015). 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).

The activity area is located in the Western Bass Strait Transition Provincial Bioregion using the Interim Marine and Coastal Regionalisation for Australia (IMCRA) classification (Figure 5-4) (DEH, 2006). At the mesoscale level, the activity area is located in the Otway bioregion, which is located on the continental shelf off southern Australia and the substrate is predominantly sandy sediments (DEH, 2006).

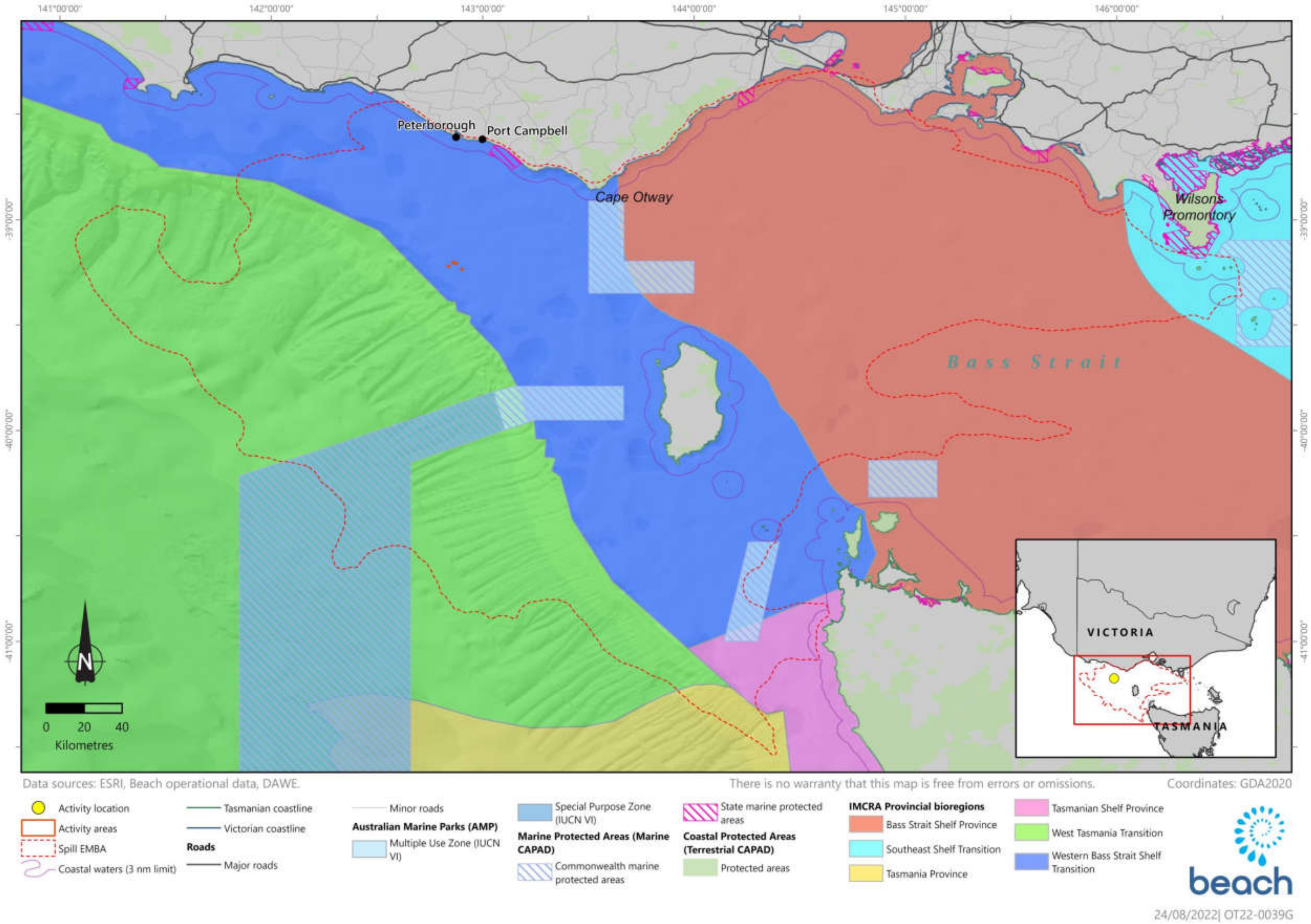


Figure 5-4: IMCRA provincial bioregions

5.3 Conservation Values and Sensitivities

5.3.1 World Heritage Properties

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

5.3.2 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 activity area (Appendix B). Four AMPs were identified within the spill EMBA PMST report and are shown in Figure 5-5. These are:

- Apollo AMP;
- Beagle AMP;
- Zeehan AMP; and
- Franklin AMP.

The SEMR are managed under the (SEMR) Network Management Plan (DNP, 2013).

5.3.2.1 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, approximately 50 km east of the activity area. The reserve covers 1,184 km^2 of Commonwealth ocean territory (DNP, 2013). The reserve encompasses the continental shelf ecosystem of the major biological zone that extends from South Australia to the west of Tasmania. The area includes the Otway Depression, an undersea valley that joins the Bass Basin to the open ocean. Apollo AMP is a relatively shallow reserve with big waves and strong tidal flows; the rough seas provide habitats for fur seals and school sharks (DNP, 2013).

The major conservation values of the Apollo AMP are:

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

5.3.2.2 Beagle AMP

The Beagle AMP is an area in shallow continental shelf depths of about 50 m to 70 m, which extends around south-eastern Australia to Tasmania covering an area of 2,928 km^2 (DNP, 2013). The reserve is located approximately 315 km east of the activity area and 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).

5.3.2.3 Zeehan AMP

The Zeehan AMP is located approximately 64 km south of the activity area and covers an area of 19,897 km^2 to the west and south-west of King Island in Commonwealth waters surrounding north-western Tasmania (DNP, 2013). It covers a broad depth range from the shallow continental shelf depth of 50 m to the abyssal plain which is over 3,000 m deep. The reserve spans the continental shelf, continental slope and deeper water ecosystems of the major biological zone that extends from South Australia to the west of Tasmania. Four submarine canyons incise the continental slope, extending from the shelf edge to the abyssal plains. A rich community made up of large sponges and other permanently attached or fixed invertebrates is present on the continental shelf, including giant crab (*Pseudocarcinus gigas*). Concentrations of larval blue wahoo (*Seriolella brama*) and ocean perch (*Helicolenus spp*.) demonstrate the role of the area as a nursery ground.

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

The major conservation values for the Zeehan AMP are:

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

5.3.2.4 Franklin AMP

The Franklin AMP is located approximately 183 km southeast of the activity area and 25 km off the north-west coast of Tasmania in waters ranging from 40 m to 150 m deep over a total area of 671 km^2. The reserve represents an area of shallow continental shelf ecosystems and incorporates the major bioregions of western Bass Strait and the Tasmanian shelf (DNP, 2013). The ocean reserve provides feeding grounds for seabirds including species of albatross, petrel, shearwater and cormorant that have breeding colonies on the nearby Hunter group of islands. Great white sharks are also known to forage in the reserve (DNP, 2013).

5.3.3 Victorian and Tasmanian Protected Areas

Victoria has a large network of onshore and offshore protected areas that are established, protected and managed under the *National Parks Act 1982* (Vic) by Parks Victoria. Offshore, there are 24 Victorian marine national parks and sanctuaries. The nine marine protected areas and nine onshore protected areas (i.e., reserves that extend to the low-water mark) intersected by the EMBA are shown in Figure 5-5 and described in Table 5-3.

Tasmania has a large network of onshore and offshore protected areas that are established, protected and managed under the *National Parks and Reserves Management Act 2002* (Tas) and *Nature Conservation Act 2002* (Tas) by DPIPWE. Offshore, there are seven marine reserves and 14 marine conservation areas (with the latter restricted to waters around Hobart in southern Tasmania). No marine protected areas are intersected by the activity area. The protected areas intersected by the spill EMBA are shown in Figure 5-5 and described in Table 5-4, moving anti-clockwise through the spill EMBA beginning at King Island. Note, where official management plans are not available for Tasmanian protected areas, information has been obtained from the Protected Planet (2020) database.

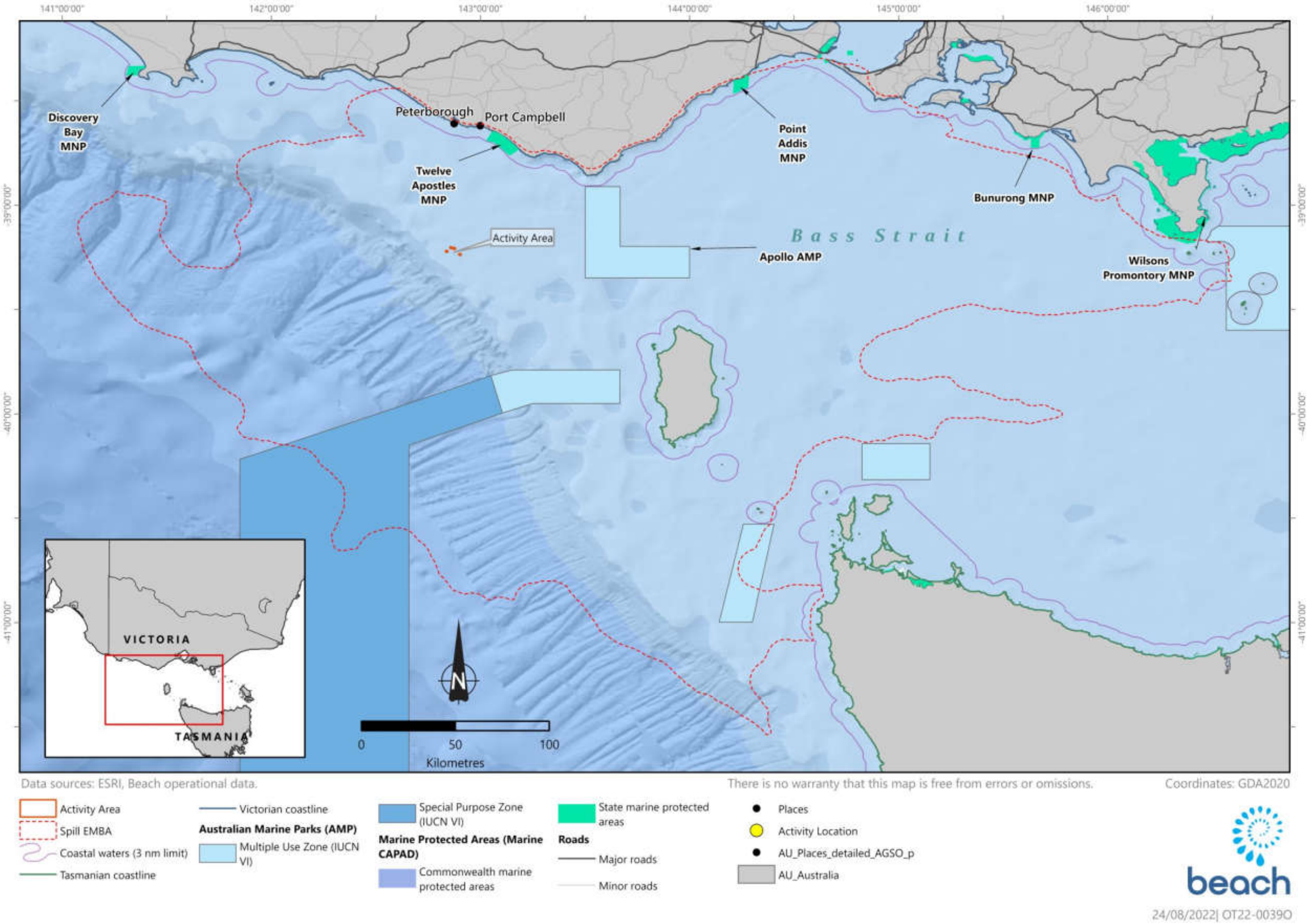


Figure 5-5: Australian Marine Parks and State Protected Areas within the spill EMBA

Table 5-3: Victorian marine and coastal protected areas in, or near, the spill EMBA

Name	Distance and direction from the activity area	Description
Marine protected areas		
The Arches Marine Sanctuary	63 km north.	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 (Parks Victoria, 2006b).
Twelve Apostles Marine and National Park	55 km northeast.	The Twelve Apostles Marine National Park (75 km^2) is located 7 km east of Port Campbell and covers 16 km of coastline from east of Broken Head to Pebble Point and extends offshore to 5.5 km (Plummer *et al.*, 2003). The area is representative of the Otway Bioregion and is characterised by a submarine network of towering canyons, caves, arches and walls with a large variety of seaweed and sponge gardens plus resident schools of reef fish. The park contains areas of calcarenite reef supporting the highest diversity of intertidal and sub-tidal invertebrates found on that rock type in Victoria (Parks Victoria, 2006b). The park includes large sandy subtidal areas consisting of predominantly fine sand with some medium to coarse sand and shell fragment (Plummer *et al.*, 2003). Benthic sampling undertaken within the park in soft sediment habitats at 10 m, 20 m and 40 m water depths identified 31, 29 and 32 species respectively based upon a sample area of 0.1 m^2. These species were predominantly polychaetes, crustaceans and nematodes with the mean number of individuals decreasing with water depth (Heisler & Parry, 2007). No visible macroalgae species were present within these soft sediment areas (Plummer *et al.*, 2003). 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.
Marengo Reefs Marine Sanctuary	83 km northeast.	The Marengo Reefs Marine Sanctuary covers 12 ha in Victorian 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, 2007b).
Point Addis Marine National Park	142 km northeast.	Point Addis Marine National Park lies east of Anglesea and covers 4,600 hectares. 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 environmental, cultural and social values for the sanctuaries including a high diversity of algal, invertebrate and fish species, evidence of a long history of aboriginal use, significant coastal seascapes and spectacular underwater scenery for snorkelling and scuba diving.

Name	Distance and direction from the activity area	Description
Eagle Rock Marine Sanctuary	133 km northeast.	Eagle Rock Marine Sanctuary covers 17 ha of Victorian waters and is located about 40 km south-west of Geelong, close to Aireys Inlet. The sanctuary extends from the high water mark around Split Point between Castle Rock and Sentinel Rock to 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 (Parks Victoria, 2005a).
Port Phillip Heads Marine National Park	180 km northeast.	Port Phillip Heads Marine National Park is an area of 35.8 km^2 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. Habitats found within the park include are seagrass beds, sheltered intertidal mudflats, intertidal sandy beaches, rocky shores, subtidal soft substrate and subtidal 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).
Mushroom Reef Marine Sanctuary	199 km northeast.	Mushroom Reef Sanctuary is located on the Bass Strait coast at Flinders near the western entrance to Western Port Bay and is 80 ha in size. The sanctuary abuts the Mornington Peninsula National Parkland and extends from the high-water mark to approximately 1 km offshore. The sanctuary's key natural values are listed in the Mushroom Reef Marine Sanctuary Management Plan (Parks Victoria, 2005b) 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; and Excellent opportunities for underwater recreation activities such as diving and snorkelling among accessible subtidal reefs.
Wilsons Promontory MNP	290 km east. Extends along 70 km of coastline on the southern tip of Wilsons Promontory National Park including Victorian state waters.	Wilsons Promontory MNP is a distinct bioregion of Victoria's coastline due to the different types of rock present and its position at the boundary between two major ocean currents. Its offshore islands support several colonies of Australian fur-seals and provide breeding sites for many seabirds, including cape barren geese, little penguins, gulls, mutton birds and ospreys (Parks Victoria, 2006c). Wilsons Promontory MNP is the first in Australia to receive a Global Ocean Refuge Award, joining a group of ten marine protected areas that comprise the Global Ocean Refuge System. The award signifies that the park meets the highest science-based standards for biodiversity protection and best practices for management and enforcement. Located at the southernmost tip of mainland Australia, it's one of the country's best examples of marine biodiversity protection (Parks Victoria, 2006c).
Wilsons Promontory Marine Park	289 km east.	Wilsons Promontory Marine Park, together with the Marine Reserve and MNP, make significant contributions to Victoria's marine protected areas. The marine park includes biological communities with distinct biogeographic patterns, including shallow subtidal reeds,

Name	Distance and direction from the activity area	Description
		deep subtidal reefs, intertidal rocky shores, sandy beaches, seagrass, subtidal soft substrates and expansive areas of open water (Parks Victoria, 2006c). The marine park provides important habitat for several threatened shorebird species and islands within the park act as important breeding sites for Australian fur seals (Parks Victoria, 2006c).
Coastal/onshore protected areas (where the EMBA intersects shorelines)		
Peterborough Coastal Reserve	65 km north	
Bay of Islands Conservation Park	66 km north.	This coastal park has outstanding ocean views and geological features and covers an extensive area of the coastline (~32 km in length and 950 ha), stretching east from Warrnambool to Peterborough. Sheer cliffs and rock stacks dominate the bays, and the heathlands contain wildflowers. Beaches are accessible at some points (Parks Victoria, 1998). This park protects the terrestrial environment above the low water mark of this coastline. This Coastal Park is protected under the Port Campbell National Park and Bay of Islands Coastal Park Management Plan (Parks Victoria, 1998).
Port Campbell National Park	64 km north.	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 has recorded visits from southern right whales in its adjacent marine waters (Parks Victoria, 1998).
Great Otway National Park	57 km northeast.	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 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. (Parks Victoria and DSE, 2009). The park's key natural values are listed as: Large areas of intact native vegetation and habitats of the Otway Ranges, Otway Plain, Warrnambool Plain bioregions; Areas of forest in excellent condition, including old growth forest, cool temperate rainforests and wet forests; Large portions of the Barwon and Otway Coast river basins, linking largely unmodified headwaters to streams and rivers including the Aire, Gellibrand and Barwon rivers, then on to estuaries and the sea; A large area of essentially unmodified coastline, linking the land to marine ecosystems and MNPs;. An abundance of biodiversity, with many species and communities found nowhere else in Victoria, some of which are rare and threatened, and including some species of national significance such as the Spot-tailed Quoll, Smoky Mouse and Tall Astelia; Many sites of geological and geomorphological significance including Artillery Rocks, Dinosaur Cove, Lion Headland, Moonlight Head to Milanesia Beach, Point Sturt and View Point; and

Name	Distance and direction from the activity area	Description
		The majority of the Aire Heritage River corridor.
Elliot River – Addis Bay Coastal Reserve	93 km northeast.	Elliot River – Addis Bay Coastal Reserve is a popular tourist location on the Great Ocean Road near Apollo Bay.
Apollo Bay Coastal Reserve	80 km northeast.	This reserve protected the beach and foreshore of the coast from Petticoat creek to Marengo in southwest Victoria. The reserve is flanked by the Great Otway National Park and several seaside towns of the surf coast. There is no management plan in place for this reserve.
Lorne-Queenscliff Coastal Reserve	115 km northeast.	This reserve stretches from Lorne to Queenscliff and covers the coast shoreward of the Great Ocean Road and occasionally extends into the nearshore marine environment. The reserve features alternating rugged rocky coasts and sandy beaches located in sheltered bays. Several seaside towns abut the reserve including Torquay, Jan Juc, Barwon Heads and Anglesea. There is no management plan in place for this reserve.
Mornington Peninsula National Park	184 km northeast.	The Mornington Peninsula National Park is situated 70 km south of Melbourne and runs along the coast from Point Nepean, at the western tip of the peninsula, to Bushrangers Bay, where it turns inland along the Main Creek valley until it joins the Greens Bush section (Parks Victoria, 2013). A narrow coastal strip between Simmons Bay and Flinders also forms part of the park, as does the South Channel Fort in Port Phillip Bay. The park's key natural values are listed as: 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 particular land systems formed within the Southern Victorian Coastal Plains and the Southern Victorian Uplands; Many significant native plants and vegetation communities, 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 Many significant fauna species, including populations of the nationally significant hooded plover, over 30 species of state significance and many species of regional significance.
Wilsons Promontory National Park	287 km east.	Wilsons Promontory National Park covers an area of 50,460 ha and is the oldest existing national park in Victoria having been permanently reserved since 1905 (Parks Victoria, 2002). The park has outstanding natural values and is an important range for plants and animals including threatened species. Wilsons Promontory National Park is renowned for its coastal scenery and recreational activities including walking, camping, sightseeing, viewing wildlife, fishing and boating (Parks Victoria, 2002). The park contains habitat that supports more than 296 species of fauna, 40 of which are threatened species. Records of over 30 species of native mammals (one-third of all Victorian species) and half of all Victorian bird species have been recorded at the park (Parks Victoria, 2002).

Table 5-4: Tasmanian marine and coastal protected areas in, or near, the spill EMBA

Name	Distance and direction from the activity area	Description
Onshore Protected Areas (where the EMBA intersects shorelines)		
Reid Rocks Nature Reserve	154 km southeast.	The Reid Rocks Nature Reserve is located in the southern extremity of King Island, approximately 21.5km from Stokes Point (DPIWE, 2000). The main islet is approximately 500m long and rises to 13m above sea level. Reid Rocks became a Nature Reserve in 1978 due to being one of the only breeding sites for the Australian Fur seals in western Bass Strait (DPIWE, 2000).
Black Pyramid Rock Nature Reserve	183 km southeast.	The Black Pyramid Rock Nature Reserve is located west of Hunter Island and has a land mass of approximately 40 hectares (DPIWE, 2000). It was declared a Wildlife Sanctuary in 1964 due to being the largest known breeding site for Australasian gannets in Australia (DPIWE, 2000).
Councillor Island Nature Reserve	125 km southeast.	Councillor Island Nature Reserve is a 10.5 ha granite reserve east of King Island. There is no management plan for this reserve.
Sea Elephant Conservation Area	121 km southeast.	Sea Elephant Conservation Area covers an area of 7.31 km^2 and is located on the east coast of King Island. The critically endangered orange-bellied parrot uses the Sea Elephant estuary as a stopover on its Bass Strait crossings. There is no management plan for this area.
Cataraqui Point Conservation Area		Cataraqui Point Conservation Area is located on the west coast of King Island covering an area of 3.05 km^2 and extending from the coast to 100-200 m inland. The conservation area is designated as IUCN Category V and there is no management plan in place.
Porky Beach Conservation Area	103 km southeast.	Porky Beach Conservation Area is located on the west coast of King Island covering an area of 4.55 km^2 and extending from the coast to 100-200 m inland. The conservation area is designated as IUCN Category V and there is no management plan in place.
Cape Wickham Conservation Area	95 km southeast.	Cape Wickham Conservation Area covers a 1 km^2 section of northern coastline of Cape Wickham, King Island. Starting at the Cape Wickham golf links and ending at Disappointment Bay State Reserve. The conservation area is an IUCN category V. Images produced by google maps and google earth, show the coastal sections within this area consist primarily of rocky cliffs, with very little sand.
Christmas Island Nature Reserve	92km southeast.	Christmas Island Nature Reserve is a 95 ha IUCN Category 1a. The reserve is located 23 km east of the survey area and contains seabird rookeries and important nesting areas for little terns and hooded plovers.
New Year Island Game Reserve	91 km southeast.	New Year Island Game Reserve is a 130 ha IUCN Category VI protected area located 22 km east of the survey area. The reserve is a granite island lying to the northwest of King Island allowing for the sustainable hunting of game species (hunting season is April). The island forms part of the King Island IBA due to breeding seabirds and waders. Species include the short- tailed shearwater, fairy prion, pacific gull, silver gull and sooty oystercatcher.
Red Hut Point Conservation Area	131 km southeast.	Red Hut Point Conservation Area is an 1.92 km^2 section on the southeastern coast of King Island. The conservation area is an IUCN category V. Images produced by google maps and google earth show the conservation area consists of both rocky cliffs and shorelines as well as sandy beaches such as Colliers beach.
Seal Rocks State Reserve	125 km southeast.	Seal Rocks State Reserve is on 5.84 km^2 area on the southwestern coast of King Island. The state reserve is an IUCN category III. Images produced by google maps and google earth, show the coastal sections of the reserve consist primarily of large rocks and rocky cliffs.

Name	Distance and direction from the activity area	Description
Stokes Point Conservation Area	130 km southeast.	Stokes Point Conservation Area is a 2.45 km^2 area located at the southernmost tip of the Island. The conservation area is an IUCN category 5. Images produced by google maps and google earth, show the coastal sections of the reserve consist primarily of large rocks and rocky cliffs.
City of Melbourne Bay Conservation Area	133 km southeast.	The City of Melbourne Bay Conservation Area is located on the east coast of King Island and covers an area of 2.11 km^2. The area is designated as IUCN Category V, which is a protected landscape/seascape. There is no management plan for this area.
Disappointment Bay State Reserve	100 km southeast.	Disappointment Bay State Reserve is a 0.69 km^2 area part of the Northern coastline of King Island. The reserve is an IUCN category II. Images produced by google maps and google earth, show the costal areas of the reserve consists predominately of sandy beach.
Lavinia State Reserve	111 km southeast.	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.
Rodondo Island Nature Reserve	299 km east.	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).
West Moncoeur Island Nature Reserve	309 km east.	West Moncoeur Island Nature Reserve is an area of 0.14 km^2 that is situated 2.5 km east of East Moncoeur Island. West Moncoeur is part of the Rodondo Group. It supports large breeding colonies of Australia fur-seals (Carlyon *et al.*, 2015).
East Moncoeur Island Conservation Area	312 km east.	East Moncoeur Island is part of Tasmania's Rodondo Group. It is designated as IUCN Category V which is a protected landscape/seascape. There is no management plan for the East Moncoeur Island Conservation Area.

5.3.4 National Heritage Places

The places of National Heritage that were identified in the spill EMBA PMST Report (Appendix B) are located onshore, outside the spill EMBA, 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).

5.3.5 Commonwealth Heritage Places

The spill EMBA PMST Report (Appendix B) identified two Commonwealth Heritage Places, both of which are historic heritage places located on land and therefore are outside the spill EMBA. The heritage places are:

- Cape Wickham Lighthouse (Historic, Listed place); and
- Sorrento Post Office VIC (Historic, Listed place).

5.3.6 Wetlands of International Importance

The spill EMBA PMST Report (Appendix B) identified three marine or coastal Wetlands of International Importance (Ramsar-listed wetlands) (Figure 5-6). 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).

5.3.6.1 Lavinia Ramsar Site

The Lavinia Ramsar site is within the spill EMBA and 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 (DAWE, 2019).

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 (DAWE, 2019).

The Lavinia State Reserve is one of the few largely unaltered areas of the island and contains much of the remaining native vegetation on King Island. The vegetation communities include Succulent Saline Herbland, Coastal Grass and Herbfield, Coastal Scrub and King Island Eucalyptus globulus Woodland. The freshwater areas of the Nook Swamps are dominated by swamp forest. Nook Swamps and the surrounding wetlands contain extensive peatlands (DAWE, 2019).

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 (DAWE, 2019).

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 (DAWE, 2019).

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 (Newall and Lloyd, 2012).

5.3.6.2 Port Philip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is within the spill EMBA and is in the western portion of Port Phillip Bay, near the city of Geelong in Victoria. The 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.

5.3.6.3 Western Port Ramsar Site

Western Port is outside of the spill EMBA, approximately 60 km south-east of Melbourne, Victoria. 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 Rasmar 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.

5.3.7 Nationally Important Wetlands

The spill EMBA PMST Report (Appendix B) identified 12 Nationally Important Wetlands (Figure 5-6). Seven of these are above the high water mark and therefore not discussed.

5.3.7.1 Lake Connewarre State Wildlife Reserve (Victoria)

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.

5.3.7.2 Lavinia Nature Reserve (Tasmania)

The Lavinia Nature Reserve encompasses the Elephant River Estuary and associated mudflats, areas of coastal swamp, lagoons and areas of drier marsh inland from the coast (DAWE, 2019). Lavinia is also a wetland of international significance and is described in Section 5.3.6.1. The site is a refuge for regional and nationally threatened species (including the orange-bellied parrot) and provides recreational experiences including boating, fishing, camping and off-road driving.

5.3.7.3 Lower Aire River Wetlands (Victoria)

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.

5.3.7.4 Princetown Wetlands (Victoria)

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.

5.3.7.5 Western Port (Victoria)

Western Port is a large bay with extensive intertidal flats, mangroves, saltmarsh, seagrass beds, several small islands and two large islands. Western Port is also a wetland of international significance and is described in Section 5.3.6.3.

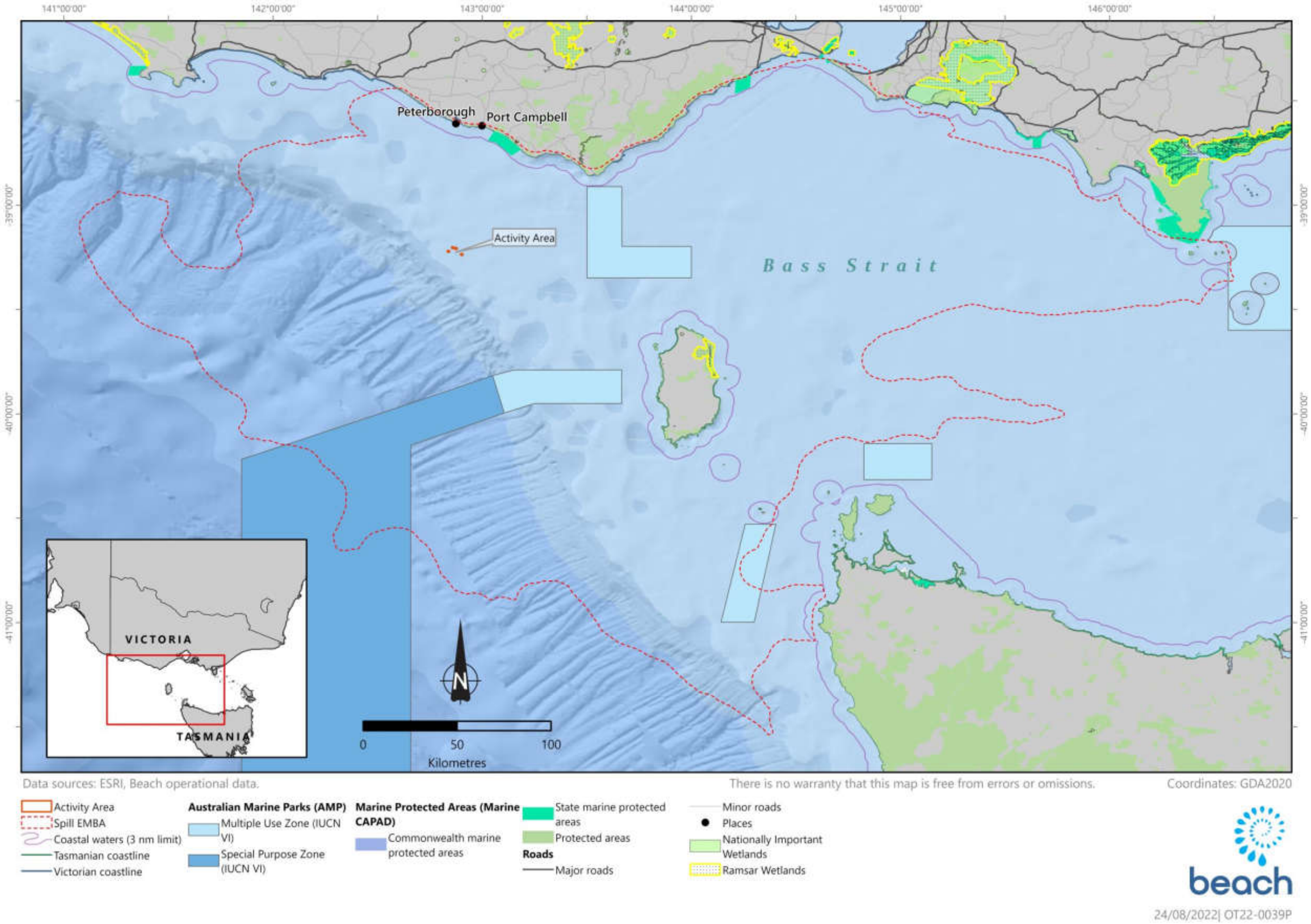


Figure 5-6: Ramsar and Nationally Important Wetlands within the spill EMBA

5.3.8 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 B) 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 fum (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 5-7). No Threatened Ecological Communities were identified within the activity area.

5.3.8.1 Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community (EPBC Act: Endangered)

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).

5.3.8.2 Giant Kelp Marine Forests of South East Australia (EPBC Act: Endangered)

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 (DSEWPaC, 2012).

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

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

Figure 5-7 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).

5.3.8.3 Subtropical and Temperate Coastal Saltmarsh (EPBC Act: Vulnerable)

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 5-7 shows that from Corner Inlet to Marlo there is a substantial amount of subtropical and temperate coastal saltmarsh along the Victorian coastline.

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

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

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

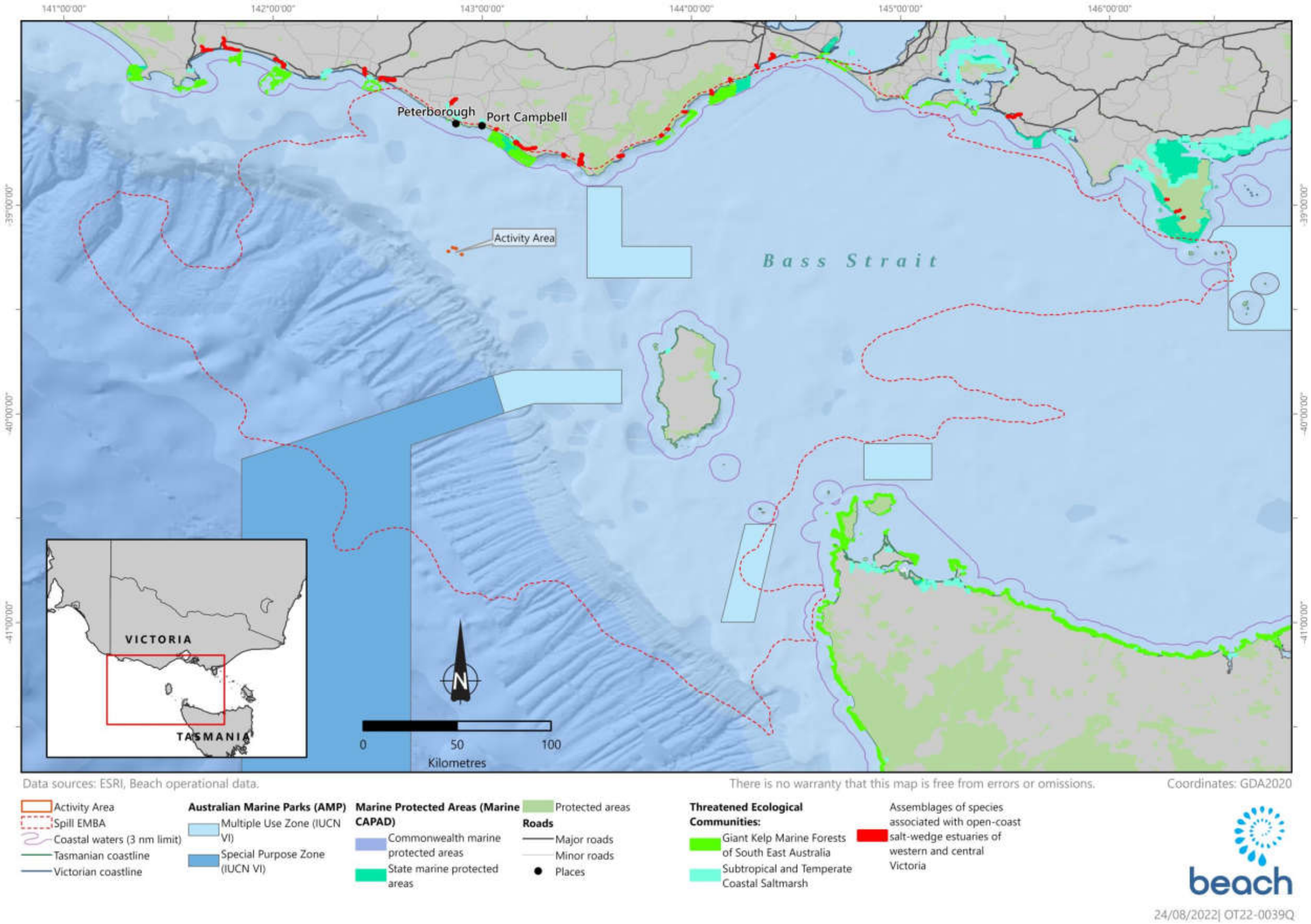


Figure 5-7: Threatened ecological communities within the spill EMBA

5.3.9 Threatened and Migratory species

PMST reports were generated for the activity area and spill EMBA to identify the listed Threatened and Migratory species that may be present (Appendix B). A total of 119 listed threatened species and 71 listed migratory species were identified as potentially occurring within the spill EMBA. There were also 116 listed marine species and 29 whales and other cetaceans identified as potentially occurring within the spill EMBA.

Under Part 13 of the EPBC Act, aspecies 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 and other cetaceans; and
- Marine.

Details of listed fauna and their likely presence in the activity area or spill EMBA are provided in Section 5.5. For the purpose of the EP, only species listed as threatened or migratory under the EPBC Act likely to occur in the activity 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.

5.3.9.1 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 National Conservation Values Atlas (Commonwealth of Australia, 2015) was searched to identify BIAs. There is no habitat critical to the survival of listed species within the activity area or spill EMBA. BIAs within the activity area and spill EMBA are summarised in Table 5-5 with further details in the relevant species sections.

Table 5-5: BIAs identified within the activity area and spill EMBA

Receptor	Activity area (1 km)	Spill EMBA	Type of BIA
Birds			
Antipodean albatross	Overlap	Overlap	Foraging
Australasian gannet	-	Overlap	Foraging
	-	Overlap	Aggregation
Black-browed albatross	Overlap	Overlap	Foraging
Black-faced cormorant	-	Overlap	Breeding
	-	Overlap	Foraging
Buller's albatross	Overlap	Overlap	Foraging
Campbell albatross	Overlap	Overlap	Foraging
Common diving-petrel	Overlap	Overlap	Foraging
	-	Overlap	Breeding
Indian yellow-nosed albatross	Overlap	Overlap	Foraging
Little penguin	-	Overlap	Foraging

Receptor	Activity area (1 km)	Spill EMBA	Type of BIA
	-	Overlap	Breeding
Short-tailed shearwater	Overlap	Overlap	Foraging
Shy albatross	Overlap	Overlap	Foraging
Wandering albatross	Overlap	Overlap	Foraging
Wedge-tailed shearwater	Overlap	Overlap	Foraging
	-	Overlap	Breeding
White-faced storm petrel	-	Overlap	Foraging
	-	Overlap	Breeding
Fish			
White shark	Overlap	Overlap	Distribution
	-	Overlap	Foraging
Australian grayling	Overlap	Overlap	Distribution
	-	Overlap	Foraging
Cetaceans			
Southern right whale	-	Overlap	Aggregation
	-	Overlap	Migration and resting on migration
	-	Overlap	Connecting habitat
Pygmy blue whale	-	Overlap	Possible Foraging Area
	Overlap	Overlap	Foraging (annual high use area)
	-	Overlap	Known Foraging Area
	Overlap	Overlap	Distribution

5.3.10 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 B) identified that the spill EMBA overlaps the West Tasmanian Marine Canyons KEF. The Bonney Coast Upwelling KEF was identified as being approximately 16 km outside of the spill EMBA but is described below due to its importance for krill production and whale foraging.

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 activity area (Figure 5-8).

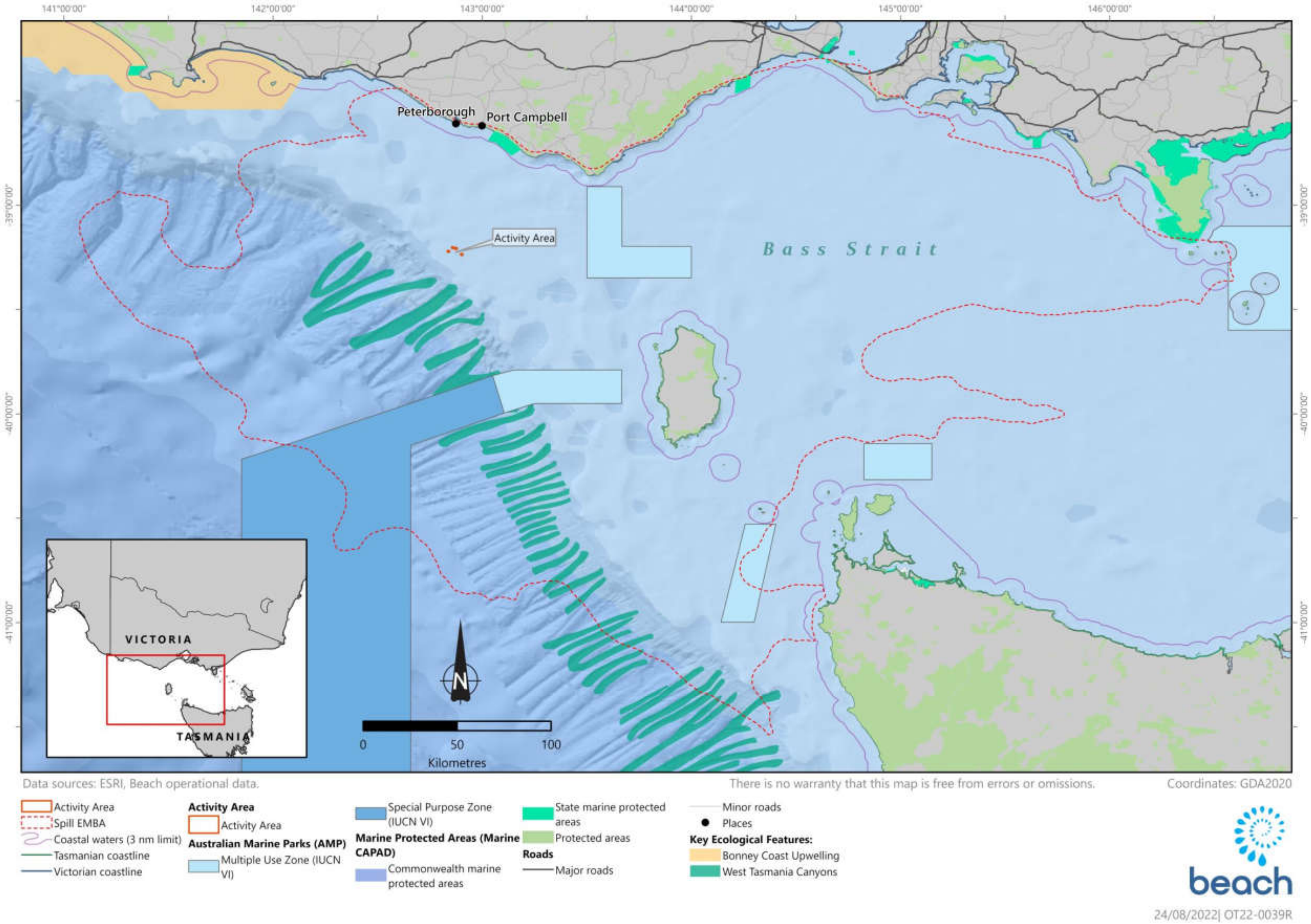


Figure 5-8: Spatially defined Key Ecological Features present within (or close to) the spill EMBA

5.3.10.1 West Tasmanian Canyons

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

Submarine canyons modify local circulation patterns by interrupting, accelerating, or redirecting current flows that are generally parallel with depth contours. Their size, complexity and configuration of features determine the degree to which the currents are modified and therefore their influences on local nutrients, prey, dispersal of eggs, larvae and juveniles and benthic diversity with subsequent effects which extend up the food chain. Eight submarine canyons surveyed in Tasmania, Australia, by Williams et al (2009) displayed depth-related patterns with regard to benthic fauna, in which the percentage occurrence of faunal coverage visible in underwater video peaked at 200-300 m water depth, with averages of over 40% faunal coverage. Coverage was reduced to less than 10% below 400 m depth. Species present consisted of low-relief bryozoan thicket and diverse sponge communities containing rare but small species in 150 to 300 m water depth.

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

5.3.10.2 Bonney Coast Upwelling

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

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

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

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

Variability

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

Ecological importance

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

The Bonney coast upwelling is one of only two identified seasonal feeding areas for blue whales in Australian coastal waters and is one of 12 known blue whale feeding aggregation areas globally. Sightings of the sei whale (*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 activity area was unlikely with an upwelling frequency for this area of <10%. The closest areas of increased frequency of upwelling events to the activity area (10-30% occasional/semi-seasonal) were small isolated areas situated in coastal areas (Figure 5-9) >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 activity area.

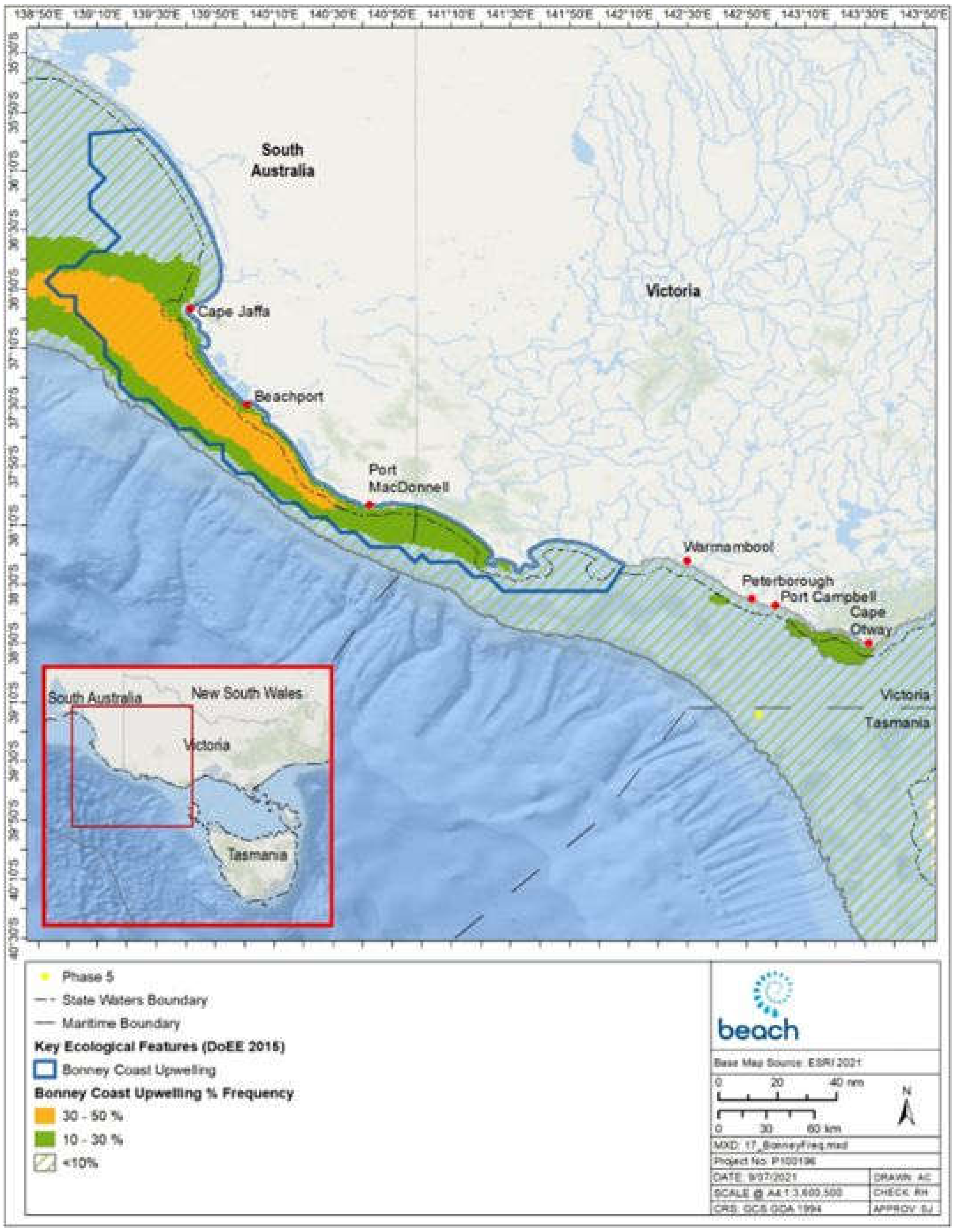


Figure 5-9: Bonney coast upwelling frequency (*Source: Huang and Wang 2019; Geoscience Australia 2020*).

5.3.10.3 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).

5.3.10.4 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).

5.4 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.

5.4.1 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 5-10).

The spill EMBA is within the five zones while the activity 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.

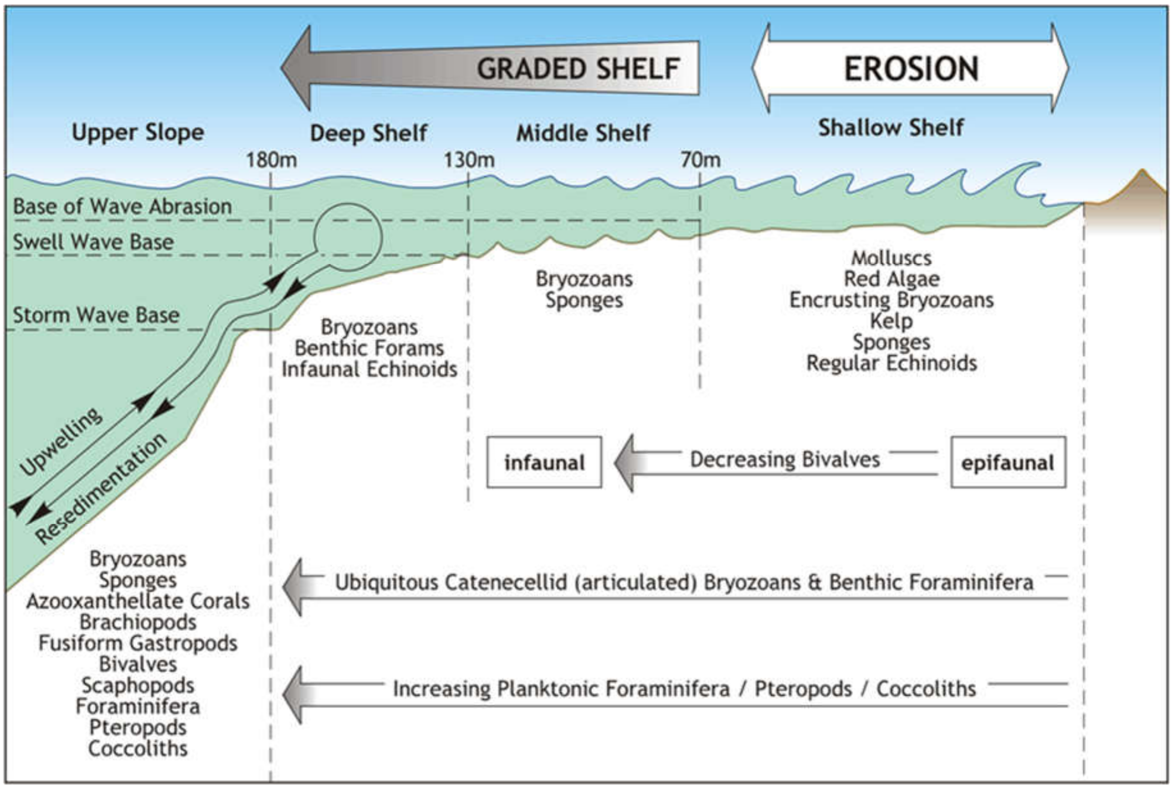


Figure 5-10: Model of the geomorphology of the Otway Shelf

5.4.2 Otway assessments and surveys - EMBA

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

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

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

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

A summary of the seabed morphology and benthic assemblages is provided in Table 5-6 through Table 5-10.

Table 5-6: 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 5-7: 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 5-8: 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 5-9: Geographe to Rifle Range seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

Depth (m)	Seabed morphology	Benthic assemblage
82	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Very low density sessile; large sponge.
79		Diverse, low – high density sessile
75	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density, sessile: sponge, dominated. Motile: sea urchins dominated
74		Medium density, sessile: sponge, dominated
70		Low - Medium density, sessile: sponge, dominated
67		Diverse, med density sessile, sponge dominated

Depth (m)	Seabed morphology	Benthic assemblage
66	Low profile limestone with sand gutters	Medium density, sessile: sponge, dominated
66	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Diverse, med density sessile, sponge dominated
70	(Pock marks) Data not documented.	Medium density, sessile: sponge, dominated
63	Corse gravel to fine sand	High density sessile: micro algae dominated

Table 5-10: 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 5-11). Sediments were described in the field from a visual impression or according to the classification of Shepard (Shepard, 1954) (Table 5-11). 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.

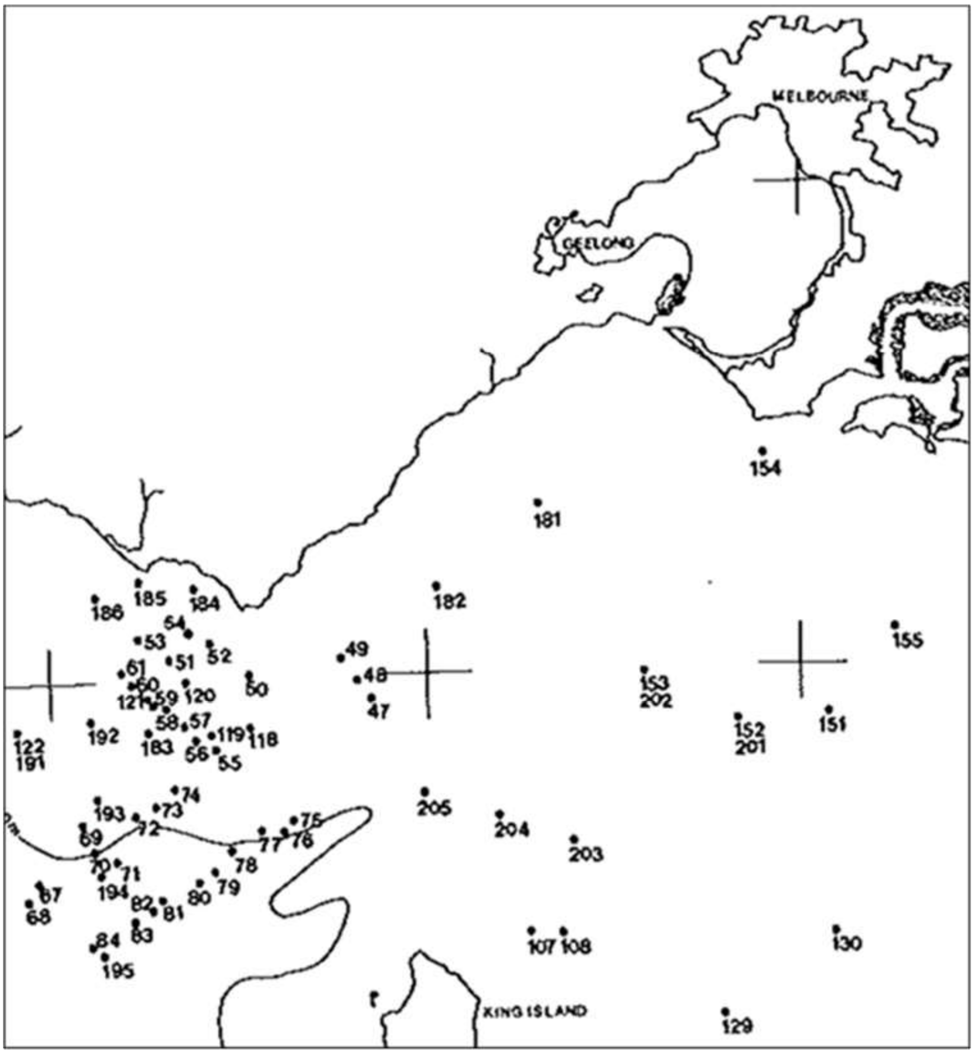


Figure 5-11: Sampling sites for the Bass Straight survey in the region of the spill EMBA (Wilson and Poore, 1987)

Table 5-11: Classification of surficial sediments 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
118	95	Fine sand	96
119	92	Fine sand	99

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
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 5-12). BBG (2003) found that the substrate in water depths between 82 and 66 m (such as those in the activity 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 5-12.

Table 5-12: 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
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

Site No.	Depth (m)	Seabed type	Benthic Assemblage
2291	67		Diverse, med density sessile, sponge dominated
2191	66	Low profile limestone with sand gutters	Medium density, sessile: sponge, dominated
2181	66	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Diverse, med density sessile, sponge dominated
1191	63	Coarse gravel to find sand	High density sessile: micro algae dominated
1668	53	Sand	None observed

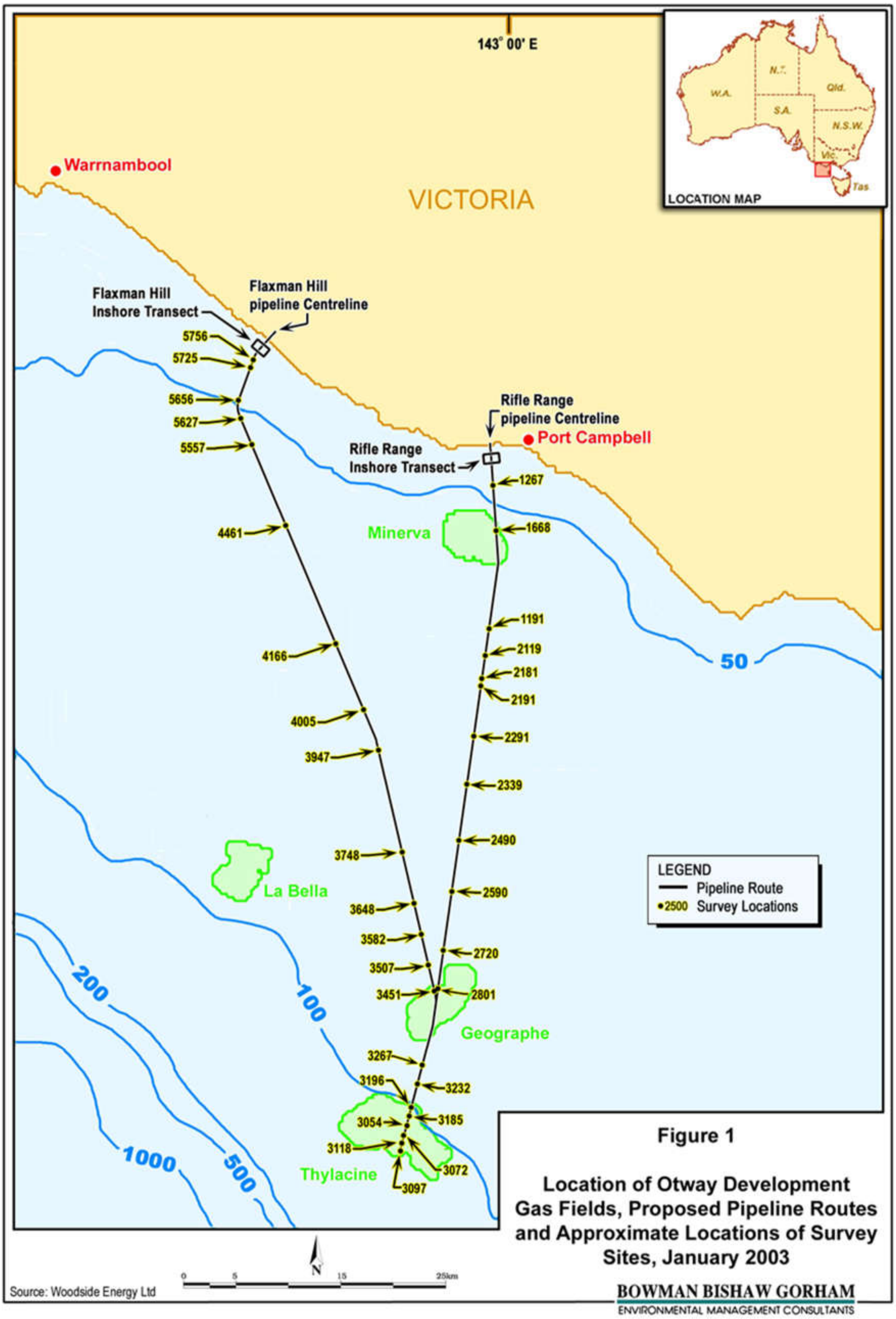


Figure 5-12: Seabed sites assessed by video survey during 2003 (BBG, 2003)

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 5-13.

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). 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 activity 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). 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 5-13). Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant. Further analysis of epifauna from a grab samples at Artisan (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 a unmodifed marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2. A microscopic examination of a qualitative sample of this epibiota indicated that this complex of fauna provide microhabitat for a range of macrofauna such as amphipods, isopods, polychaete worms and molluscs. Such epifaunal habitats are known to provide refuge and other resources for benthic species (Jones, 2006). By comparison, there was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.

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

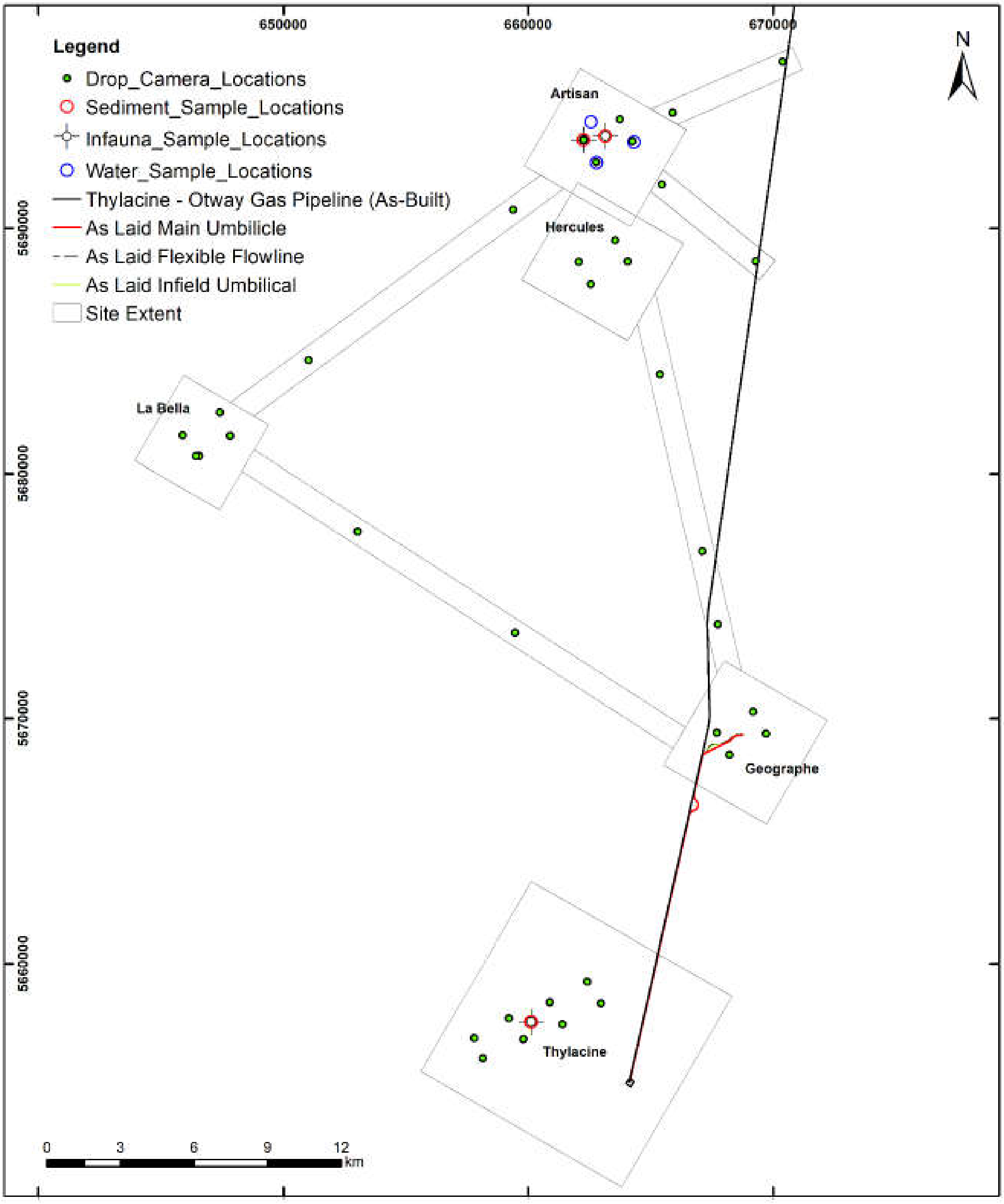


Figure 5-13: Location of the Otway Gas Development seabed site assessment

5.4.3 Otway assessments and surveys- Activity area

As detailed in Section 5.4.2, 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 5-13.

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 activity described in this EP 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). The drop camera locations are shown in Figure 5-14. 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 compromises of rocky outcrops of the regionally-dipping Port Campbell limestones.
- Sands are coarse (siliceous) calcareous medium sand.
- A local relief of up to 3 m is identified on the rocky scarp surfaces, which are separated by shallow depressions often with a transgressive sandy infill.
- The percentage epifauna cover from the eight drop camera sites ranged from zero to 65% with an average percentage cover of 14%.
- Predominantly hard seabed with coarse sand substrates that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges).
- The epibiota on the seabed in the vicinity of the Thylacine gas fields is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates.

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.

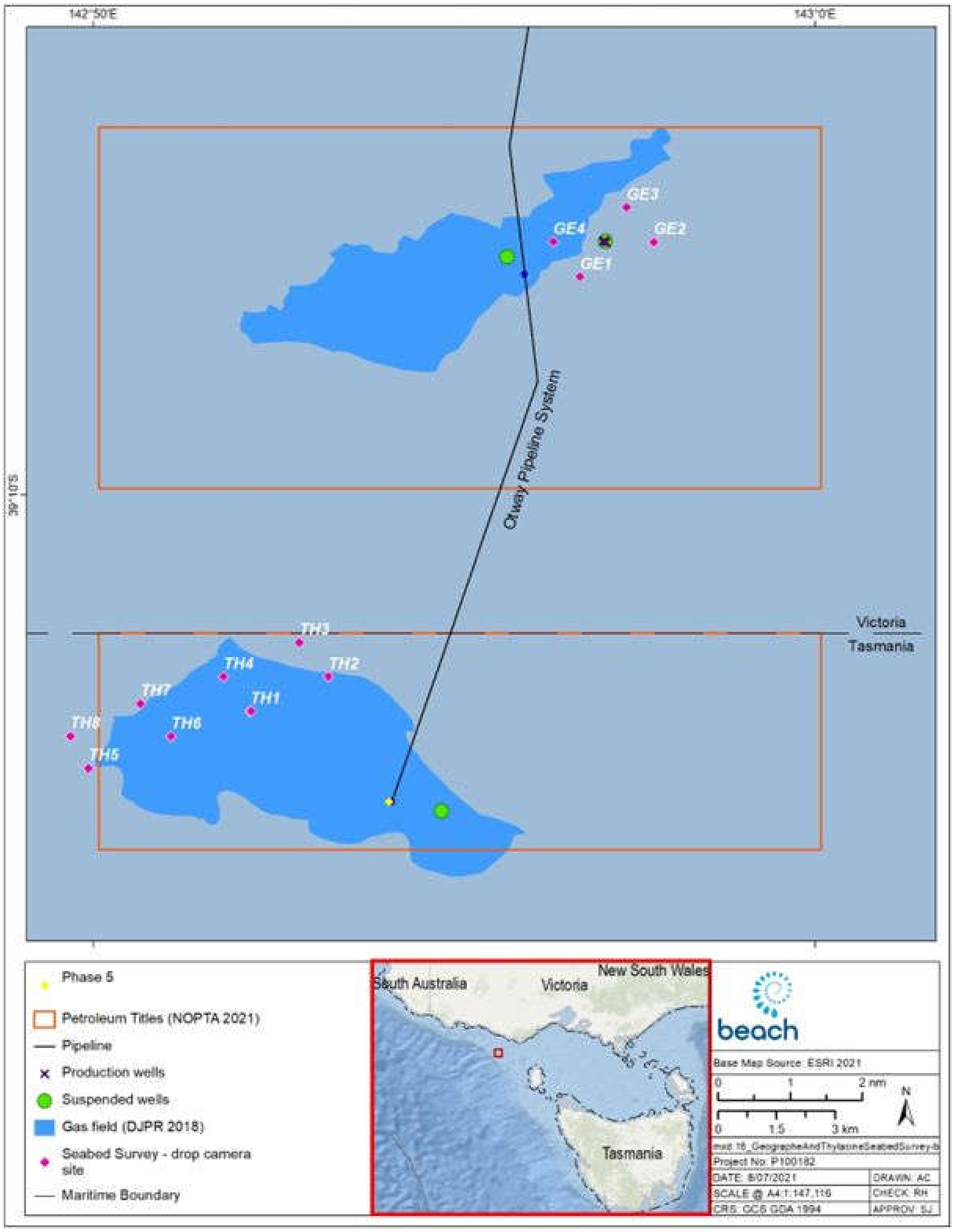


Figure 5-14: Drop camera locations within activity area

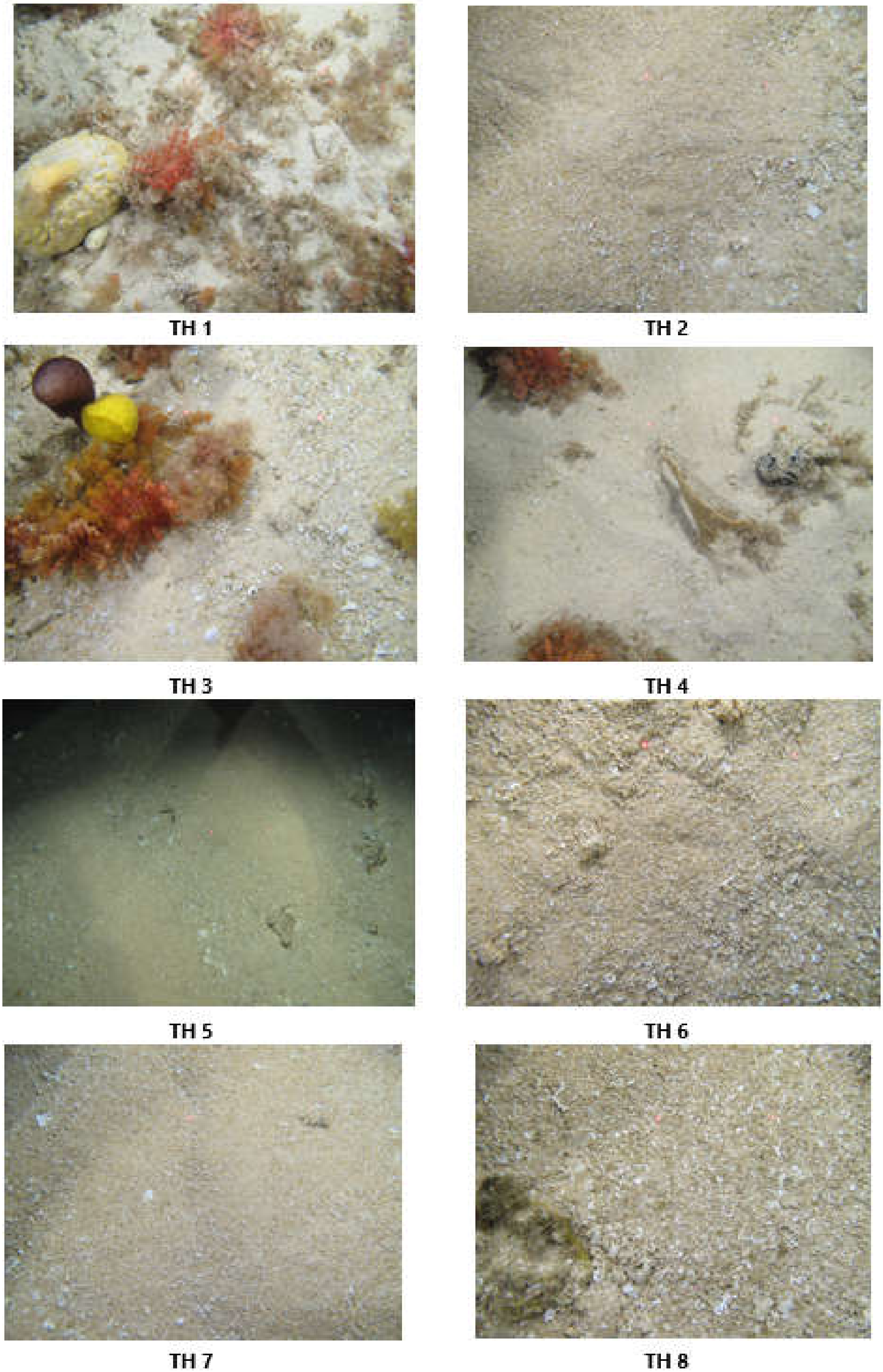


Figure 5-15: Drop camera images

5.4.4 Metocean conditions

5.4.4.1 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.

5.4.4.2 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 5-16).

5.4.4.3 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).

5.4.4.4 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 5-17). During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Straight. In winter and spring, waters within the straight are well mixed with no obvious stratification, while during summer the central regions of the straight become stratified.

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

5.4.4.5 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.

5.4.4.6 Sea temperature

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

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

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

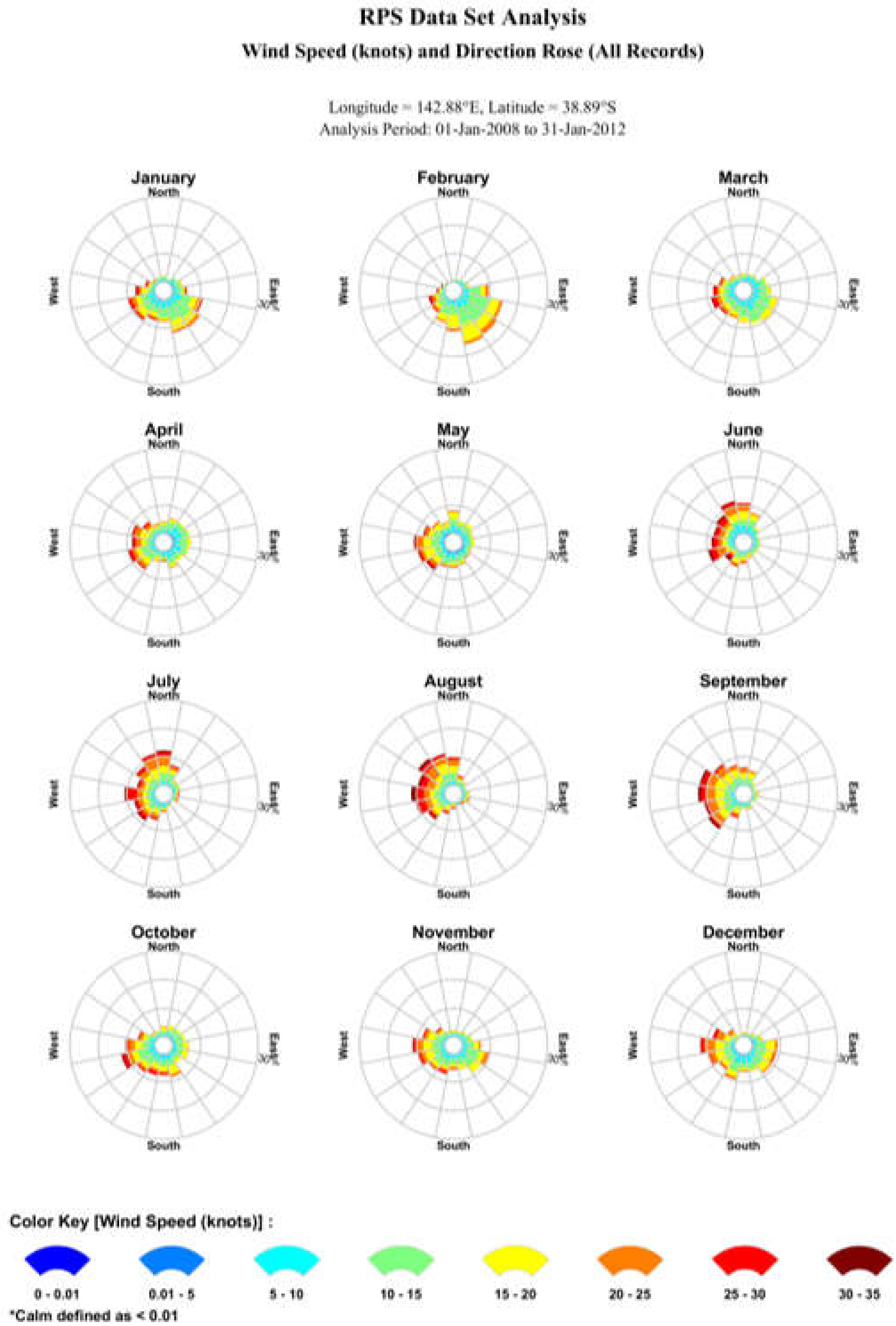


Figure 5-16: Modelled monthly wind rose distributions (RPS, 2019)

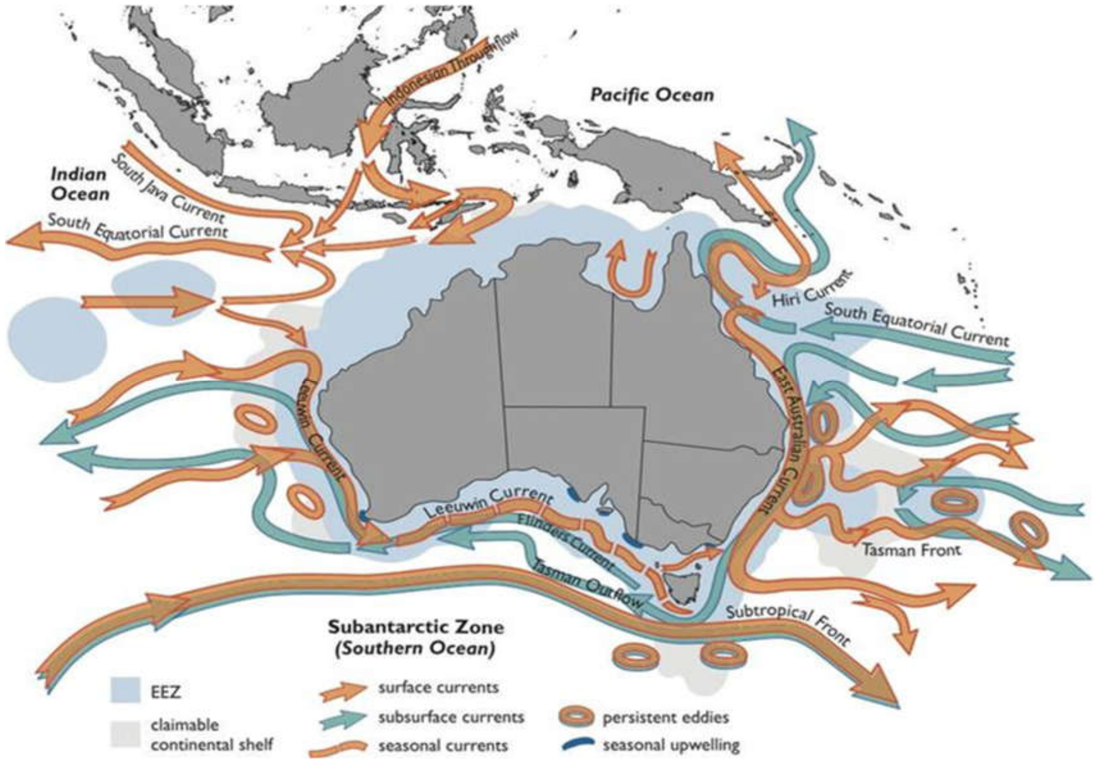


Figure 5-17: Australian ocean currents

5.4.5 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).

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 (Woodside, 2003).

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

- The Thylacine site was relatively quiet with only the passage of several boats (about ten) evident.
- The rig tender and drill rig noise show clearly from 13:00 on the 3 May 2001.
- Drill rig noise was evident as sharp tones.

- Rig tender noise was evident either at a low but persistent level for days or in short bursts of high level noise for several hours associated with manoeuvring, use of thrusters or as a close passage by the receiver.
- The horizontal banding characteristic of persistent calling by pygmy blue whales was not evident, rather these call types occurred infrequently and at low levels indicating the respective sources were at long range.
- Evidence of low-level, distant evening fish choruses only.

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

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

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

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

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

5.4.6 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). 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 activity 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.

5.4.7 Sediment quality

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020). 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 activity area and spill EMBA will be typical of the offshore marine environment of the Otway Basin.

5.4.8 Air quality

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

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

The Geelong monitoring station is the closest to the activity 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 activity 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 (CO_2), methane (CH_4), nitrous oxide (N_2O) and synthetic GHGs such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

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

5.5 Ecological environment

5.5.1 Benthic habitats and species assemblages

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

The Otway continental margin is a swell-dominated, open, cool-water carbonate platform which can be divided into depth-related zones (Figure 5-10, 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 5.4.2 and 5.4.3, is medium to coarse carbonate sands with areas of low relief exposed limestone (Ramboll, 2020). Drop camera images of seabed at the Thylacine survey locations are shown in Figure 5-15.

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

5.5.1.1 Soft Sediment

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

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

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

5.5.1.2 Seagrass

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

Seagrass generally grows in soft sediments within intertidal and shallow subtidal waters where there is sufficient light and are common in sheltered coastal areas such as bays, lees of islands and fringing coastal reefs (McClatchie et al., 2006; McLeay et al., 2003). Known seagrass meadows within the 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 Victorian coastline.

5.5.1.3 Algae

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

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

5.5.1.4 Coral

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

Corals is not listed as a dominant habitat type within the activity 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) 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).

5.5.1.5 Carbonate sands and exposed limestone

Boreen et al. (1993) reported that carbonate sands in the Otway middle shelf support a benthic fauna dominated by bryozoans, infaunal echinoids and assemblages of sponges. Other components include bivalves (commonly *Mysella donaciformis* and *Legrandina bernardi*), *Chlamys* sp. scallops and small gastropods. The 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 course, well-sorted sand (Currie and Jenkins, 1994). This survey identified 196 species and a total of 5,035 individuals comprised of 63% crustaceans, 15% polychaetes, 8% molluscs and 5% echinoderms. The most abundant species were the bivalve *Katlysia* sp. (12.4 individuals/m^2), the sarconid (*Triloculina affinis)* (8.9 individuals/m^2), the tanaid isopod *Apsuedes* sp. (8.3 individuals/m^2) and the spionid polychaete (*Prionospio coorilla*) (4.8 individuals/m^2) (Currie, 1995).

Demersal fishes likely to be associated with carbonate sands on the middle and inner shelf include (LCC, 1993) eastern stargazer (*Kathetostoma laeve*), elephant shark (*Callorhynchus milli*), greenback flounder (*Rhombosolea 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*).

5.5.1.6 Basalt rises

There is no published information on the species assemblages of the basalt rises in the southeast 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 activity 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.

5.5.2 Mangroves

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

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

5.5.3 Saltmarsh

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

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

5.5.4 Plankton

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

The carrying capacity of marine ecosystems (the mass of fish resources) and recruitment of individual stocks is strongly related to plankton abundance, timing and composition. In the 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.

5.5.5 Invertebrates

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

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

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

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 bodies invertebrates to survive and establish significant populations. (Ramboll 2020)

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.

5.5.6 Fish

Fish species present in the activity 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. Table 5-13 details the listed fish species identified in the spill EMBA and activity area PMST reports.

Table 5-13: Listed fish species identified in the PMST report

Common name	Species name	EPBC Act listing status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Fish							
Australian grayling	*Prototroctes maraena*	V	-	-	SHK	-	RP
Orange Roughy	*Hoplostethus atlanticus*	CD			SHL	SHL	
Eastern Gemfish	*Rexea solandri*	CD			SHL	-	
Blue Warehou	*Seriolella brama*	CD			SHK	SHK	
Southern Bluefin Tuna	*Thunnus maccoyii*	CD			SHL	SHL	
Sharks and rays							
Porbeagle, mackerel shark	*Lamna nasus*	-	M	-	SHL	SHL	
Southern dogfish	*Centrophorus zeehaani*	CD	-	-	SHL	SHL	
School shark	*Galeorhinus galeus*	CD	-	-	SHK	SHL	
Shortfin mako	*Isurus oxyrinchus*	-	M	-	SHL	SHL	
White shark	*Carcharodon carcharias*	V	M	-	FFK	SHK	RP
Pipefish, seahorse, seadragons							
Upside-down pipefish	*Heraldia nocturna*	-	-	L	SHM	SHM	
Bigbelly seahorse	*Hippocampus abdominalis*	-	-	L	SHM	SHM	
Short-head seahorse	*Hippocampus breviceps*	-	-	L	SHM	SHM	
Bullneck Seahorse	*Hippocampus minotaur*	-	-	L	SHM	-	

Common name	Species name	EPBC Act listing status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Briggs' crested pipefish	*Histiogamphelus briggsii*	-	-	L	SHM	SHM	
Rhino pipefish	*Histiogamphelus cristatus*	-	-	L	SHM	SHM	
Knife-snouted pipefish	*Hypselognathus rostratus*	-	-	L	SHM	SHM	
Deep-bodied pipefish	*Kaupus costatus*	-	-	L	SHM	SHM	
Trawl pipefish	*Kimblaeus bassensis*	-	-	L	SHM	-	
Brushtail pipefish	*Leptoichthys fistularius*	-	-	L	SHM	SHM	
Australian smooth pipefish	*Lissocampus caudalis*	-	-	L	SHM	SHM	
Javelin pipefish	*Lissocampus runa*	-	-	L	SHM	SHM	
Sawtooth pipefish	*Maroubra perserrata*	-	-	L	SHM	SHM	
Mollison's pipefish	*Mitotichthys mollisoni*	-	-	L	SHM	-	
Half-banded pipefish	*Mitotichthys semistriatus*	-	-	L	SHM	SHM	
Tucker's pipefish	*Mitotichthys tuckeri*	-	-	L	SHM	SHM	
Red pipefish	*Notiocampus ruber*	-	-	L	SHM	SHM	
Leafy seadragon	*Phycodurus eques*	-	-	L	SHM	SHM	
Common seadragon	*Phyllopteryx taeniolatus*	-	-	L	SHM	SHM	
Pug-nosed pipefish	*Pugnaso curtirostris*	-	-	L	SHM	SHM	
Robust pipehorse	*Solegnathus robustus*	-	-	L	SHM	SHM	
Spiny pipehorse,	*Solegnathus spinosissimus*	-	-	L	SHM	SHM	

Common name	Species name	EPBC Act listing status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Spotted pipefish	*Stigmatopora argus*	-	-	L	SHM	SHM	
Black pipefish	*Stigmatopora nigra*	-	-	L	SHM	SHM	
Ring-backed pipefish	*Stipecampus cristatus*	-	-	L	SHM	SHM	
Hairy pipefish	*Urocampus carinirostris*	-	-	L	SHM	SHM	
Mother-of-pearl pipefish	*Vanacampus margaritifer*	-	-	L	SHM	SHM	
Port Phillip pipefish	*Vanacampus phillipi*	-	-	L	SHM	SHM	
Australian long-snout pipefish	*Vanacampus poecilolaemus*	-	-	L	SHM	SHM	

Listed Status:

Vulnerable (V); Endangered (E); Critically Endangered (CE); Conservation Dependent (CD); Migratory (M); Listed (L)

Likely Presence

SHM: Species or species habitat may occur within area.

SHL: Species or species habitat likely to occur within area.

SHK: Species or species habitat known to occur within area.

BK: Breeding known to occur within area.

FFK: Foraging, feeding or related behaviour known to occur within area

Recovery plans:

Action Statement (AS); Conservation Advice (CA); Conservation Management Plan (CMP); Recovery Plan (RP)

5.5.6.1 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 and foraging BIAs for the white shark intersects the spill EMBA and activity area (Figure 5-18). 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.

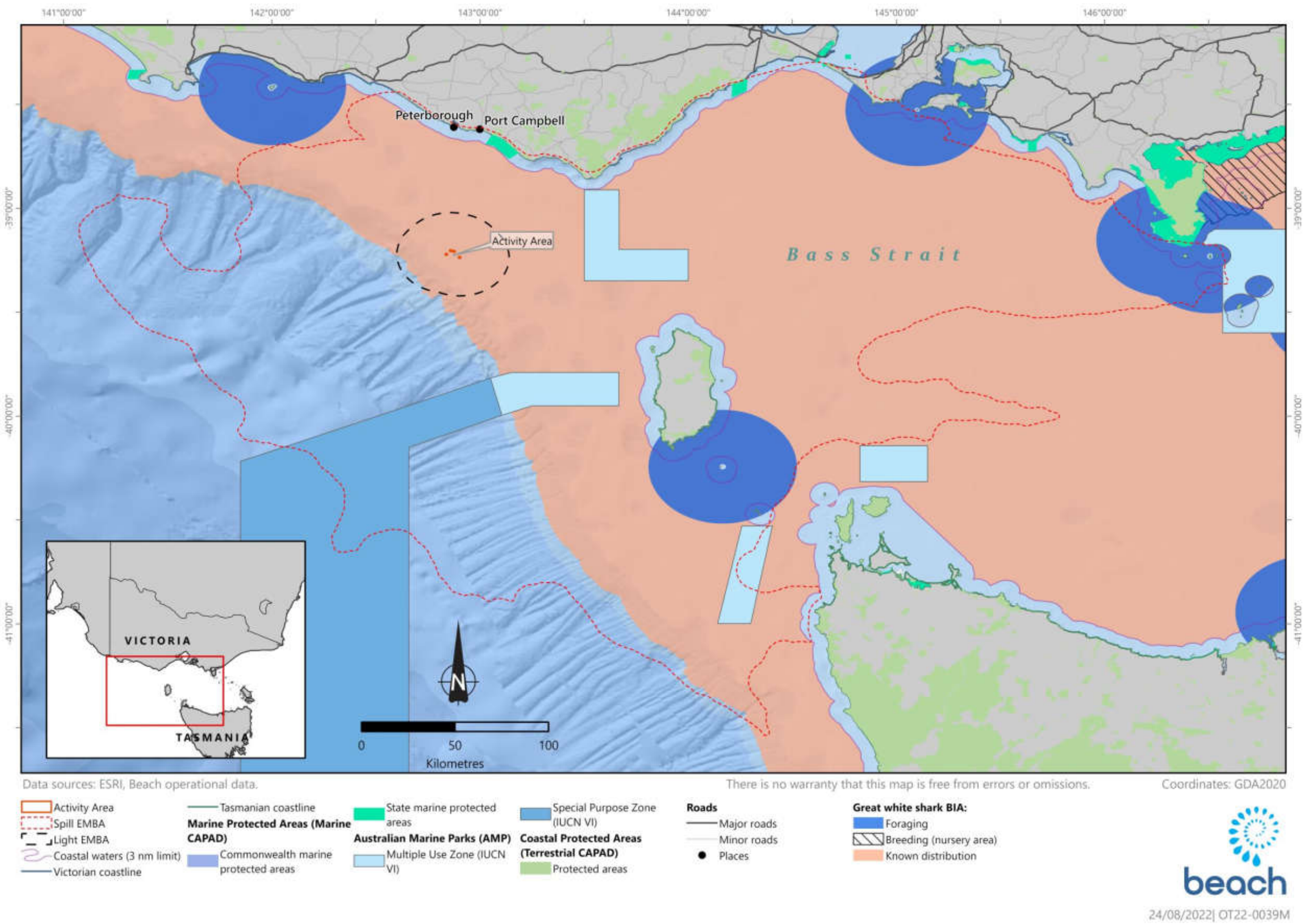


Figure 5-18: BIAs for the white shark within the spill EMBA

5.5.6.2 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 activity area and spill EMBA in low numbers.

5.5.6.3 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.

5.5.6.4 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.

5.5.6.5 Syngnathids

Most of the marine ray-finned fish species identified in the Spill EMBA and activity 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.

Only one of the syngnathids identified (*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 activity area is not expected.

5.5.7 Birds

A diverse array of seabirds and terrestrial birds utilise the Otway region and may potentially forage within or fly over the activity 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 activity area and spill EMBA (this includes species or species habitat), are shown in Table 5-14. Section 5.3.9.1 and Table 5-5 detail which species have identified BIAs within the activity area and spill EMBA. Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the activity area and spill EMBA are discussed in more detail. Many of the seabirds described below are included in the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2020b).

Table 5-14: Listed bird species identified in the PMST report (* species BIA identified)

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Albatrosses							
Antipodean albatross*	*Diomedea antipodensis*	V	M	L	FL	FL	CMP CA
Black-browed albatross*	*Thalassarche melanophris*	V	M	L	FL	FL	
Buller's albatross*	*Thalassarche bulleri*	V	M	L	FL	FL	
Campbell albatross*	*Thalassarche impavida*	V	M	L	FL	FL	
Gibson's albatross	*Diomedea antipodensis gibsoni, Diomedea gibsoni*	V	-	L	FL		
Grey-headed albatross	*Thalassarche chrysostoma*	E	M	L	SHM	SHM	
Indian yellow -nosed albatross	*Thalassarche carteri*	V	M	L	SHL	SHL	
Northern Buller's albatross	*Thalassarche bulleri platei*	V	-	-	FL	FL	
Northern royal albatross	*Diomedea sanfordi*	E	M	L	FL	FL	
Salvin's albatross	*Thalassarche salvini*	V	M	L	FL	FL	
Shy albatross*	*Thalassarche cauta*	E	M	L	FL	FL	
Sooty albatross	*Phoebetris fusca*	V	M	L	SHL	SHL	
Southern royal albatross	*Diomedea epomophora*	V	M	L	FL	FL	
Wandering albatross*	*Diomedea exulans*	V	M	L	FL	FL	
White-capped albatross	*Thalassarche steadi*	V	M	L	FL	FL	
Shearwaters							
Flesh-footed shearwater	*Ardenna carneipes*	-	M	L	SHK	FL	CMP
Short-tailed shearwater*	*Ardenna tenuirostris* *Puffinus tenuirostris*	-	M	L	BK		
Sooty shearwater	*Ardenna grisea* *Puffinus griseus*	-	M	L	SHM	SHM	

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Petrels							
White-bellied storm-petrel	*Fregetta grallaria grallaria*	V	-	-	BK		CMP
Blue petrel	*Halobaena caerulea*	V	-	L	SHM	SHM	CMP
Southern giant-petrel	*Macronectes giganteus*	E	M	L	FL	SHM	RP AS
Northern giant-petrel	*Macronectes halli*	V	M	L	FL	SHL	
Common diving petrel*	*Pelecanoides urinatrix*	-	-	L	BK		CMP
Gould's petrel	*Pterodroma leucoptera*	E	-	-	SHM	SHM	RP
Soft-plumaged petrel	*Pterodroma mollis*	V	-	L	FL	SHM	CA
Other							
Australasian bittern	*Botaurus poiciloptilus*	E	-	-	SHK		CA
Australasian gannet*	*Morus serrator*	-	-	L	FL		CMP
Australian fairy tern	*Sternula nereis nereis*	V	-	-	SHK	FL	CA, RP
Australian painted-snipe	*Rostratula australis*	E	-	-	SHK		CA
Bar-tailed godwit	*Limosa lapponica*	-	W	L	SHK		
Black currawong	*Strepera fuliginosa colei*	V	-	-	BL		CA
Black-eared cuckoo	*Chrysococcyx osculans*	-	-	L	SHK		
Black-faced cormorant*	*Phalacrocorax fuscescens*	-	-	L	BK		CMP
Black-faced monarch	*Monarcha melanopsis*	-	T	L	SHK		
Black-tailed godwit	*Limosa limosa*	-	W	L	RK		
Broad-billed sandpiper	*Limicola falcinellus*	-	W	L	RK		
Cattle egret	*Bubulcus ibis*	-	-	L	SHM		
Common greenshank	*Tringa nebularia*	-	W	L	SHK		
Common noddy	*Anous stolidus*	-	M	L	SHL		CMP
Common sandpiper	*Actitius hypoleucos*	-	W	L	SHK	SHM	

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Crested tern	*Thalasseus bergii* *Sterna bergii*	-	W	L	BK		CMP
Curlew sandpiper	*Calidris ferruginea*	CE	W	L	SHK	SHM	CA
Double-banded plover	*Charadrius bicinctus*	-	W	L	RK		
Eastern curlew	*Numenius madagacariensis*	CE	W	L	SHK	SHM	CA
Eastern hooded plover	*Thinornis cucullatus cucullatus*	V	-	L	SHK		CA
Fairy prion	*Pachyptila turtur*	-	-	L	SHK	SHM	CMP
Fairy prion (southern)	*Pachyptila turtur subantarctica*	V	-	-	SHK	SHM	CA
Fork-tailed swift	*Apus pacificus*	-	M	L	SHL		
Great knot	*Calidris tenuirostris*	CE	W	L	RK		CA
Great skua	*Catharacta skua*	-	-	L	SHM	SHM	
Greater sand plover	*Charadrius leschenaultii*	V	W	L	SHL		CA
Green rosella (King Island)	*Platycercus caledonicus brownie*	V	-	-	SHK		CA
Grey falcon	*Falco hypoleucos*	V	-	-	SHL		CA
Grey plover	*Pluvialis squatarola*	-	W	L	RK		
Grey-tailed tattler	*Heteroscelus brevipes*	-	W	L	RK		
Hooded plover	*Thinornis rubricollis*		-	L	SHK		
Hooded plover (eastern)	*Thinornis cucullatus cucullatus* *Thinornis rubricollis rubricollis*	V	-	L	SHK		CA
Kelp gull	*Larus dominicanus*	-	-	L	BK		CMP
King Island brown thornbill	*Acanthiza pusilla archibaldi*	E	-	-	SHK		King Island Biodiversity Management Plan
King Island scrubtit	*Acanthornis magna greeniana*	CE	-	-	SHK		
Latham's snipe	*Gallinago hardwickii*	-	W	L	SHK		

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Lesser sand plover	*Charadrius mongolus*	E	W	L	RK		CA
Little curlew	*Numenius minutus*	-	W	L	RL		
Little penguin*	*Eudyptula minor*	-	-	L	BK, FL		CMP
Little tern	*Sternula albifrons*	-	M	L	SHM		CMP
Magpie Goose	*Anseranas semipalmata*	-	-	L	SHM		
Marsh sandpiper	*Tringa stagnatilis*	-	W	L	RK		
Nunivak bar-tailed godwit	*Limosa lapponica baueri*	V	-	-	SHK		CA
Orange-bellied parrot	*Neophema chrysogaster*	CE	-	L	MK		RP
Osprey	*Pandion haliaetus*	-	W	L	SHK		CMP
Pacific golden plover	*Pluvialis fulva*	-	W	L	RK		
Pacific gull	*Larus pacificus*	-	-	L	BK		CMP
Painted honeyeater	*Grantiella picta*	V	-	-	SHK		CA, RP
Painted snipe	*Rostratula benghalensis (sensu lato)*	E	-	L	SHK		CA
Pectoral sandpiper	*Calidris melanotos*	-	W	L	SHK	SHM	
Pied stilt	*Himantopus himantopus*	-	-	L	RK		
Pin-tailed snipe	*Gallinago stenura*	-	W	L	RL		
Plains-wanderer	*Pedionomus torquatus*	CE	-	-	SHL		
Rainbow bee-eater	*Merops ornatus*	-	-	L	SHM		
Red knot	*Calidris canutus*	E	W	L	SHK	SHM	CA
Red-capped plover	*Charadrius ruficapillus*	-	-	L	RK		
Red-necked avocet	*Recurvirostra novaehollandiae*	-	-	L	RK		
Red-necked phalarope	*Phalaropus lobatus*	-	W	L	RK		
Red-necked stint	*Calidris ruficollis*	-	W	L	RK		

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	
Regent honeyeater	*Anthochaera Phrygia*	CE	-	-	FL		CA, RP
Ruddy turnstone	*Arenaria interpres*	-	W	L	RK		
Rufous fantail	*Rhipidura rufifrons*	-	T	L	SHK		
Sanderling	*Calidris alba*	-	W	L	RK		
Satin flycatcher	*Myiagra cyanoleuca*	-	T	L	BK		
Sharp-tailed sandpiper	*Calidris acuminata*	-	W	L	RK	SHM	
Silver gull	*Larus novaehollandiae*	-	-	L	BK		CMP
Swift parrot	*Lathamus discolour*	CE	-	L	SHK		
Swinhoe's snipe	*Gallinago megala*	-	W	L	RL		
Tasmanian azure kingfisher	*Ceyx azureus diemenensis*	E	-	-	SHL		
Tasmanian wedge-tailed eagle	*Aquila audax fleayi*	E	-	-	SHL		
Terek sandpiper	*Xenus cinereus*	-	W	L	RK		
Whimbrel	*Numenius phaeopus*	-	W	L	RK		
White-bellied sea-eagle	*Haliaeetus leucogaster*	-	-	L	BK		CMP
White-faced storm-petrel	*Pelagodroma marina*	-	-	L	FL		CMP
White-throated needletail	*Hirundapus caudacutus*	V	T	L	SHK		CA
Yellow wagtail	*Motacilla flava*	-	T	L	SHK		

Common name	Species name	EPBC Act listed status			Presence		Recovery Plan?
		Threatened	Migratory	Marine	Spill EMBA	Activity area (1 km)	

Listed Threatened
- CE: Critically Endangered
- E: Endangered
- V: Vulnerable

Listed Migratory
- M: Migratory
- T: Migratory Terrestrial
- W: Migratory Wetlands

Listed Marine
- L: Listed

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

Recovery plans:

Action Statement (AS); Conservation Advice (CA); Conservation Management Plan (CMP); Recovery Plan (RP)

5.5.7.1 Albatross and petrels

Albatrosses and giant-petrels spend 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 activity area and spill EMBA. Albatross Island (195 km southeast of the activity area), 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. 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 (Figure 5-19), black-browed albatross, Campbell albatross, wandering albatross, Indian yellow-nosed albatross (Figure 5-20), Buller's albatross (Figure 5-21) and shy albatross (Figure 5-22) have BIAs for foraging that overlap the activity area or spill EMBA. These BIAs cover either most or all the SEMR (Commonwealth of Australia, 2015). It is likely these species will 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 activity area and spill EMBA. The common-diving petrel also has a breeding BIA that overlaps the spill EMBA (Figure 5-23). The white-faced storm petrel has a foraging BIA that overlaps the activity area and spill EMBA, and a breeding BIA that overlaps the spill EMBA (Figure 5-24).

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 activity 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).

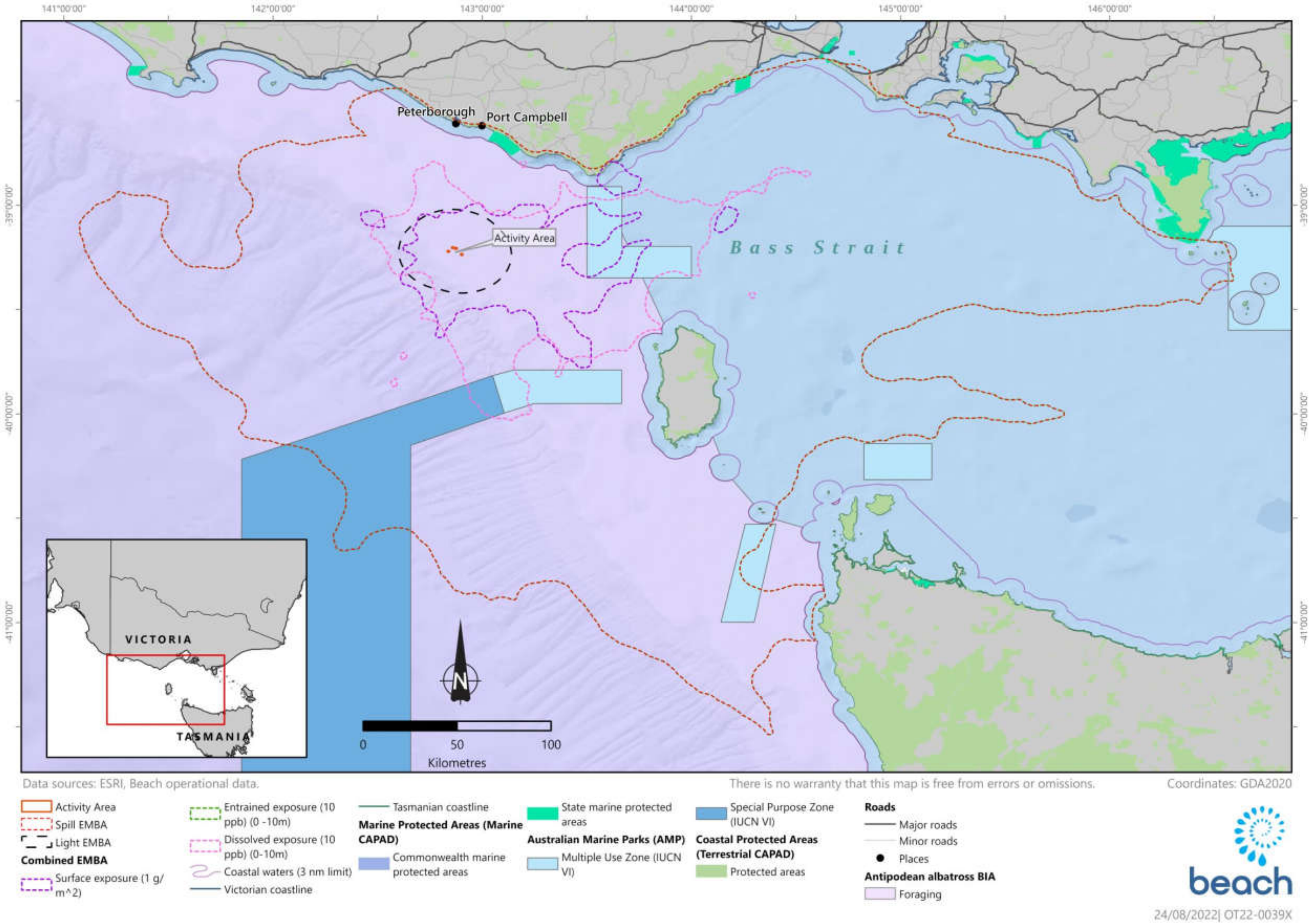


Figure 5-19: BIAs for Antipodean albatross

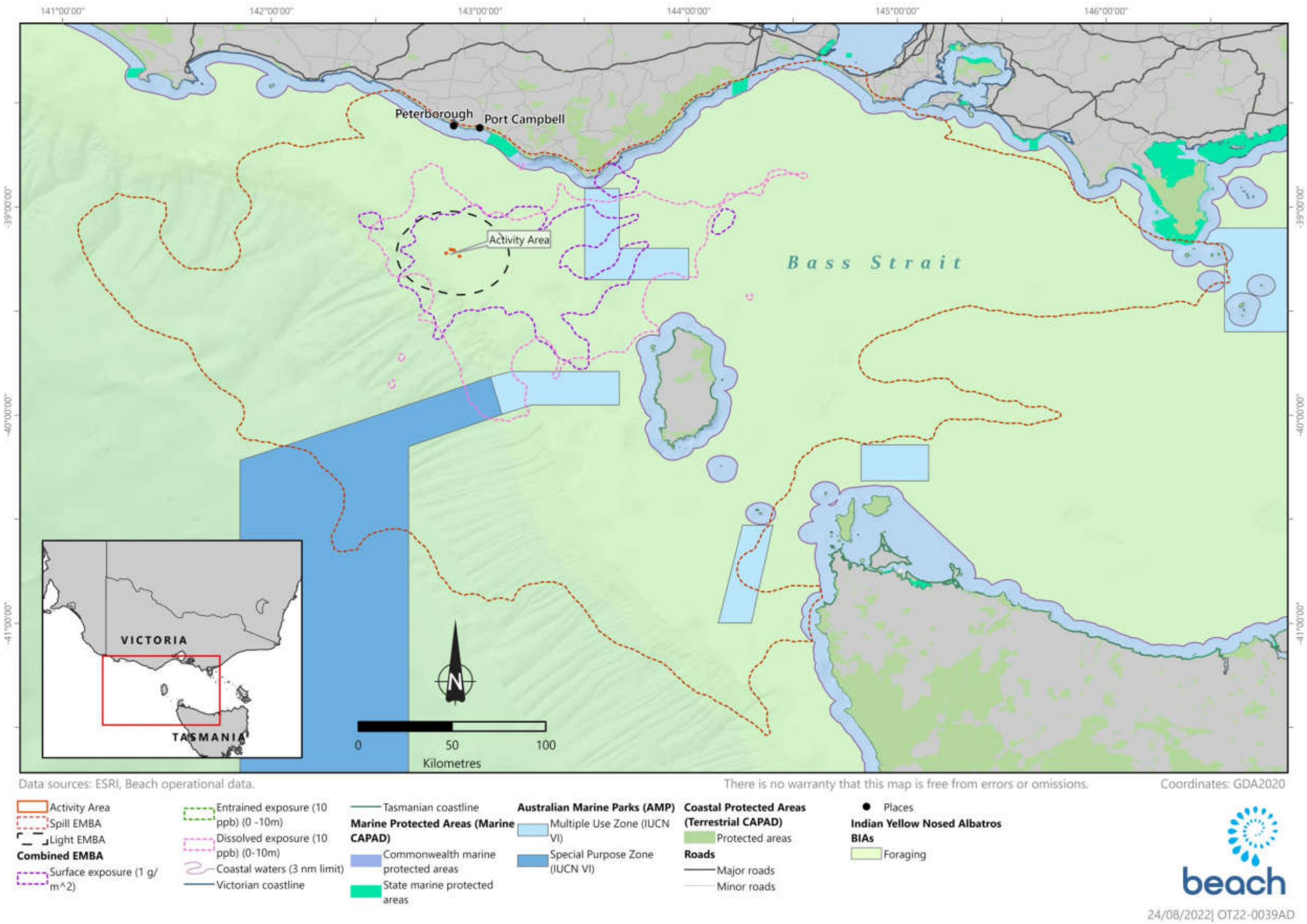


Figure 5-20: BIAs for Indian yellow-nosed albatross (NB: black-browed, Campbell and wandering albatross share this BIA)

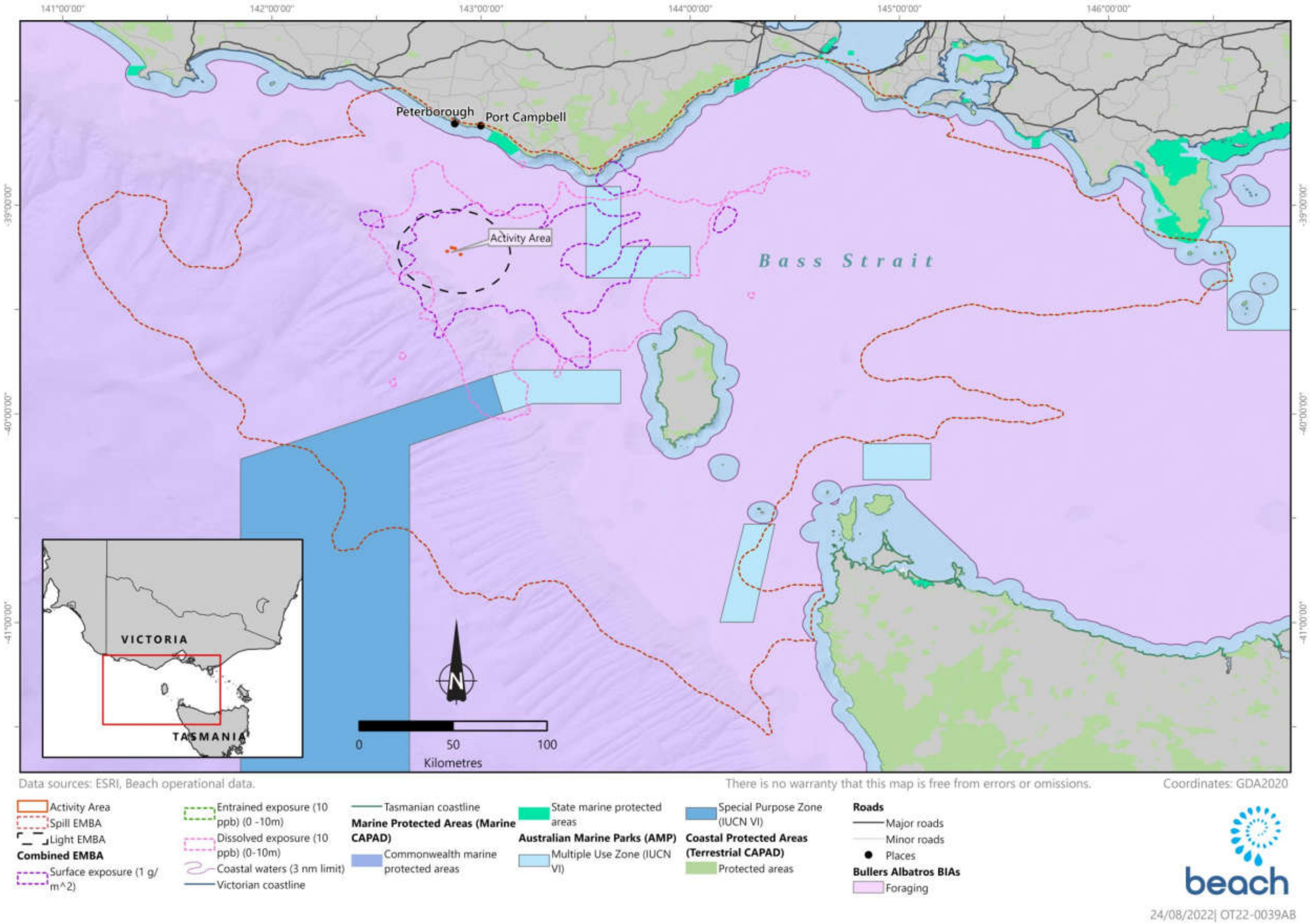


Figure 5-21: BIAs for Buller's albatross

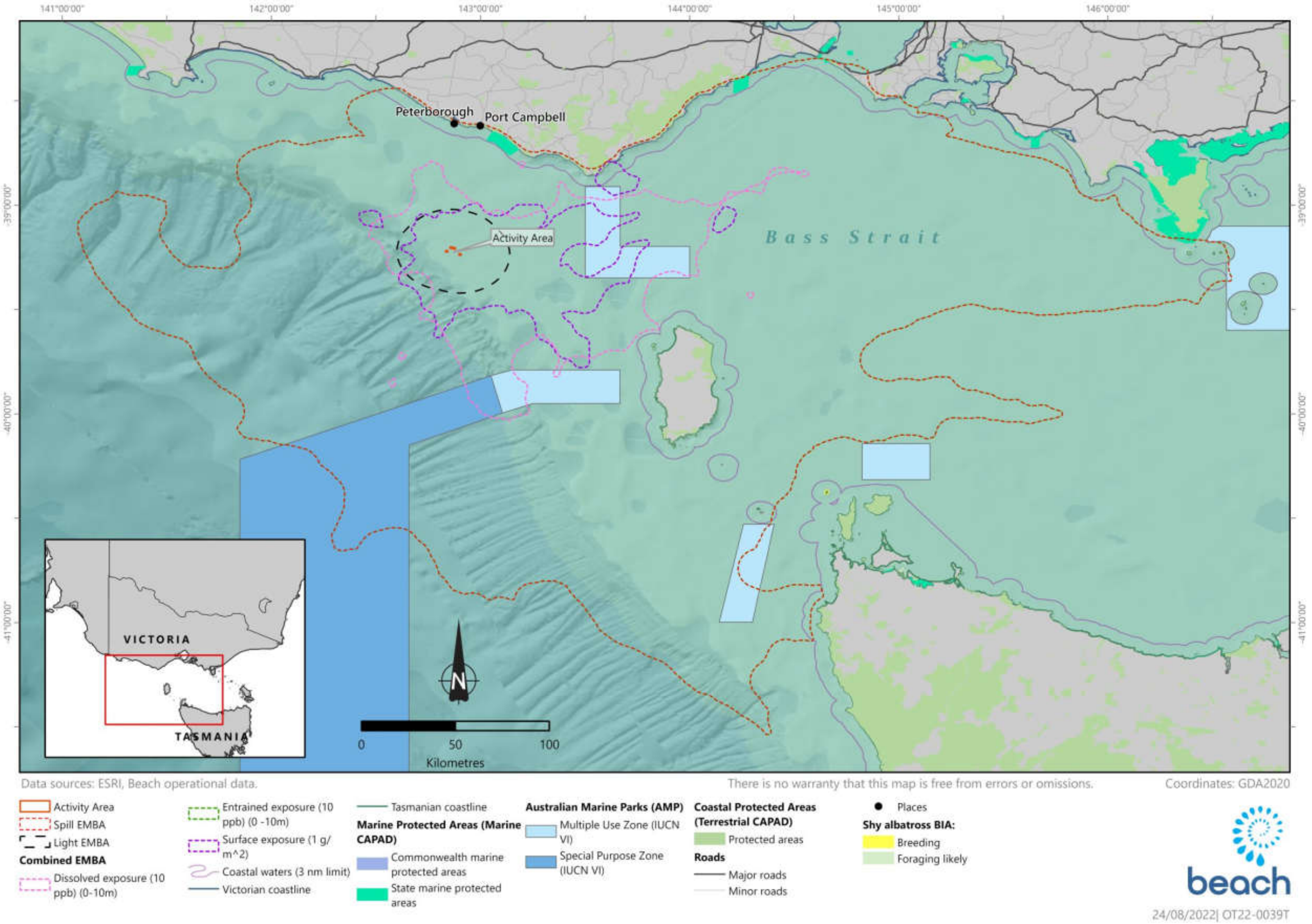


Figure 5-22: BIAs for shy albatross

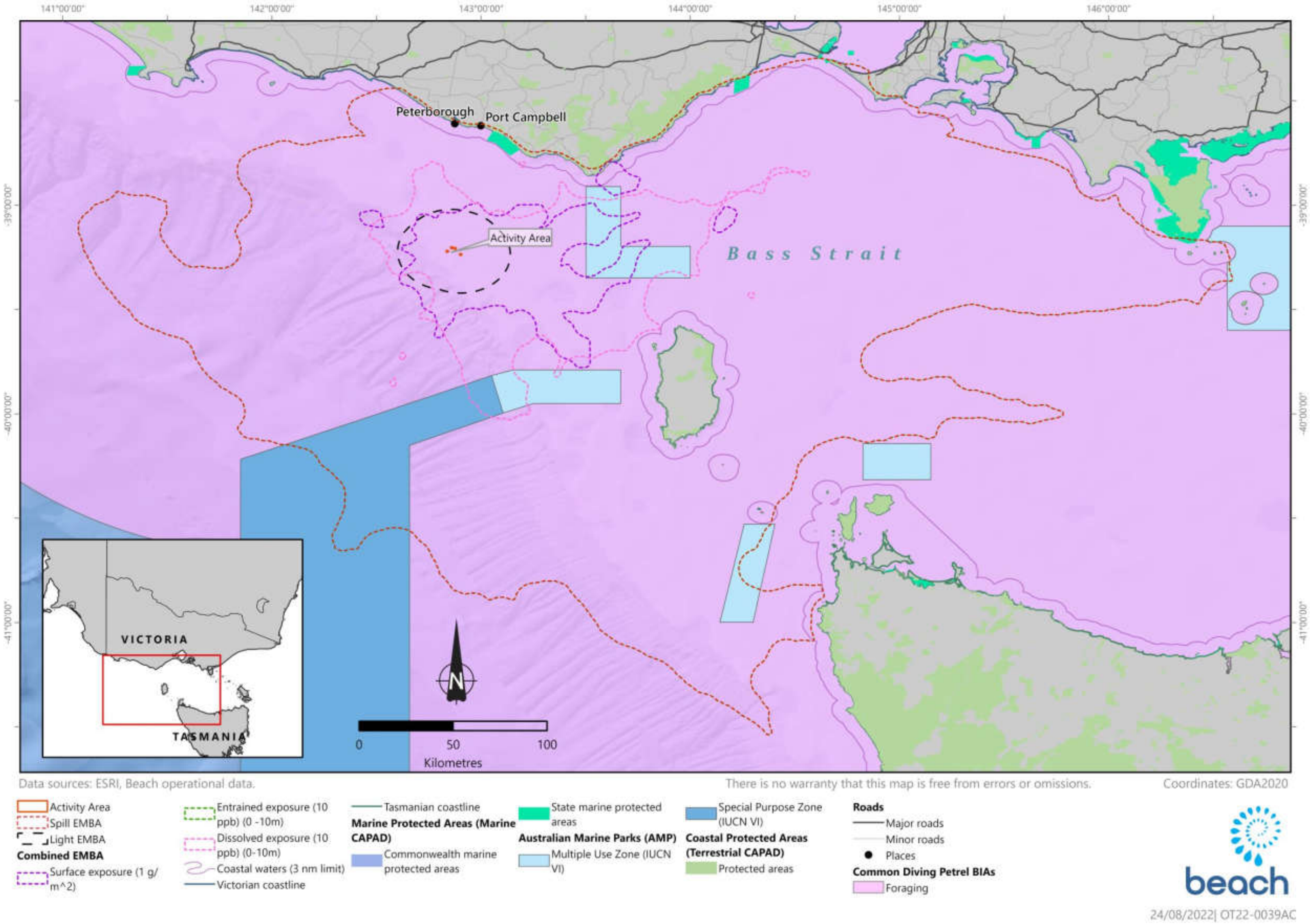


Figure 5-23: BIAs for common diving-petrel

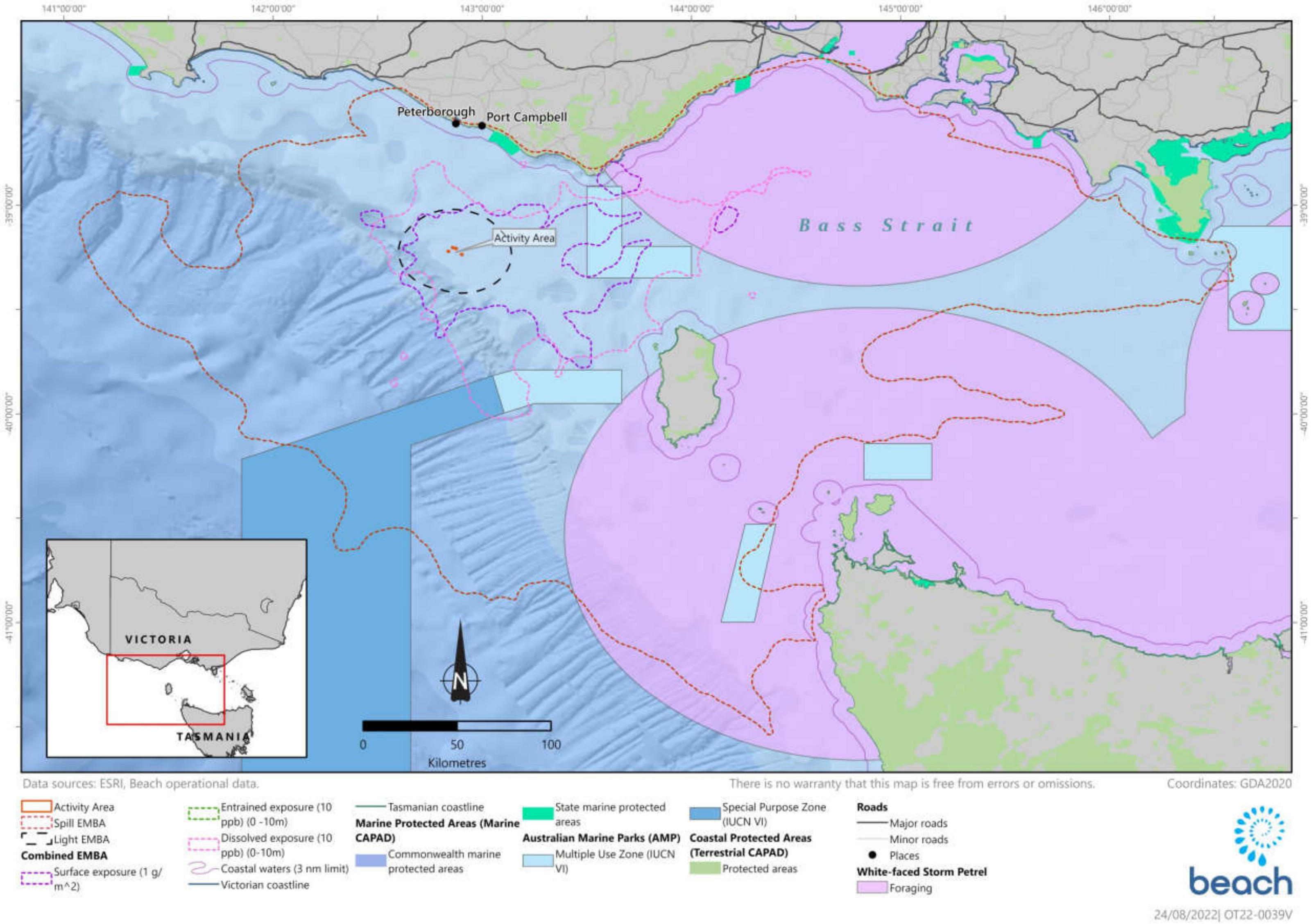


Figure 5-24: BIAs for white-faced storm petrel

5.5.7.2 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. It feeds on small fish, cephalopod molluscs, crustaceans, other soft-bodied invertebrates and offal. It obtains most of its food by surface plunging or pursuit plunging. It regularly forages by settling on 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 activity area or spill EMBA.

The short-tailed shearwater has foraging and breeding BIAs within the spill EMBA (Figure 5-25). 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 activity area and spill EMBA (Figure 5-26). 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.

The Caspian tern is the largest tern in 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 and they are resident 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, tidal channels and mud flaps. They can forage 60 km from their nesting site (Higgins & Davis, 1996). The little tern is 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.

Terns were observed amongst mixed flocks of seabirds (such as albatross and shearwaters) during the drilling of Geographe-4 in April 2021.

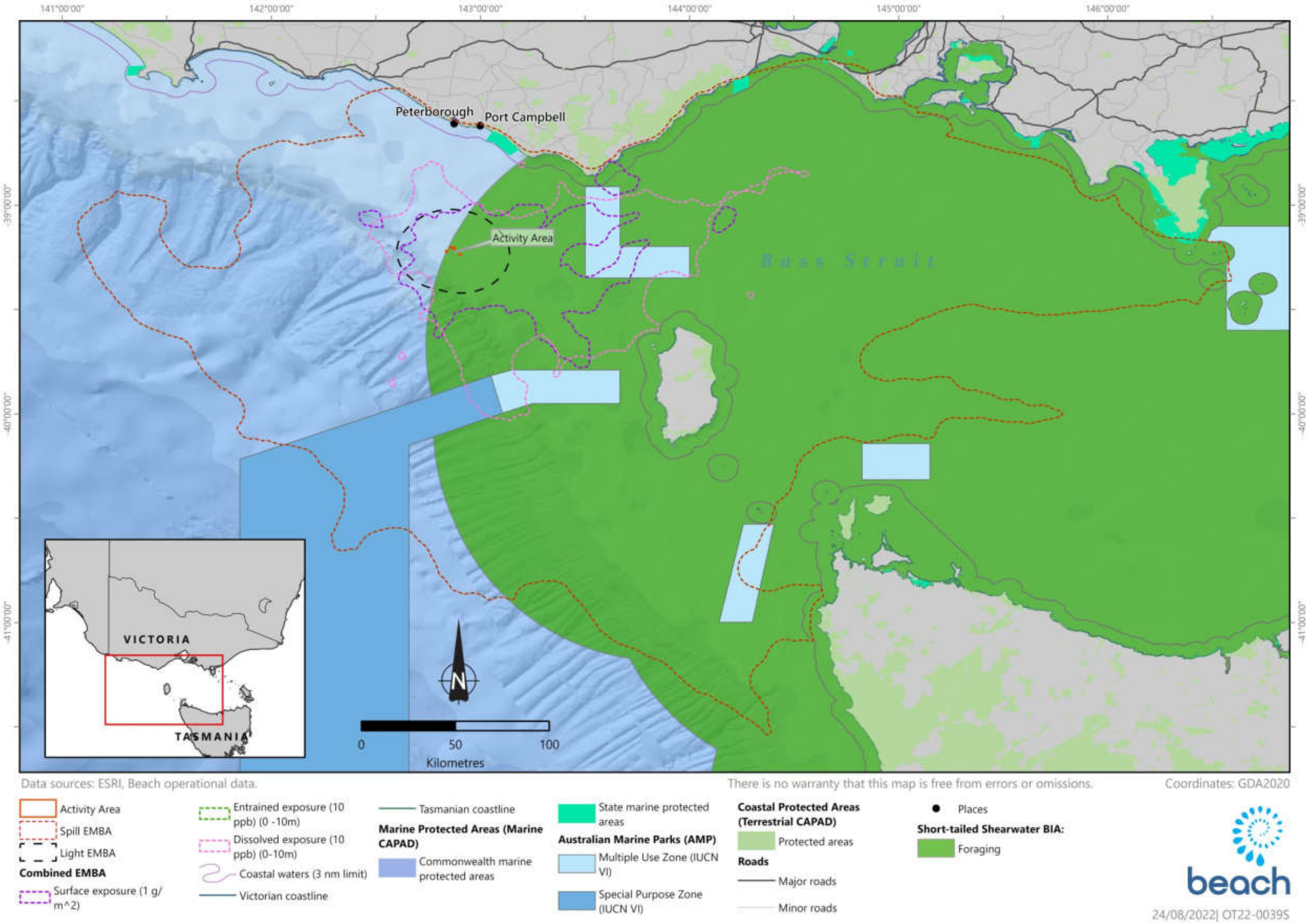


Figure 5-25: BIAs for short-tailed shearwater

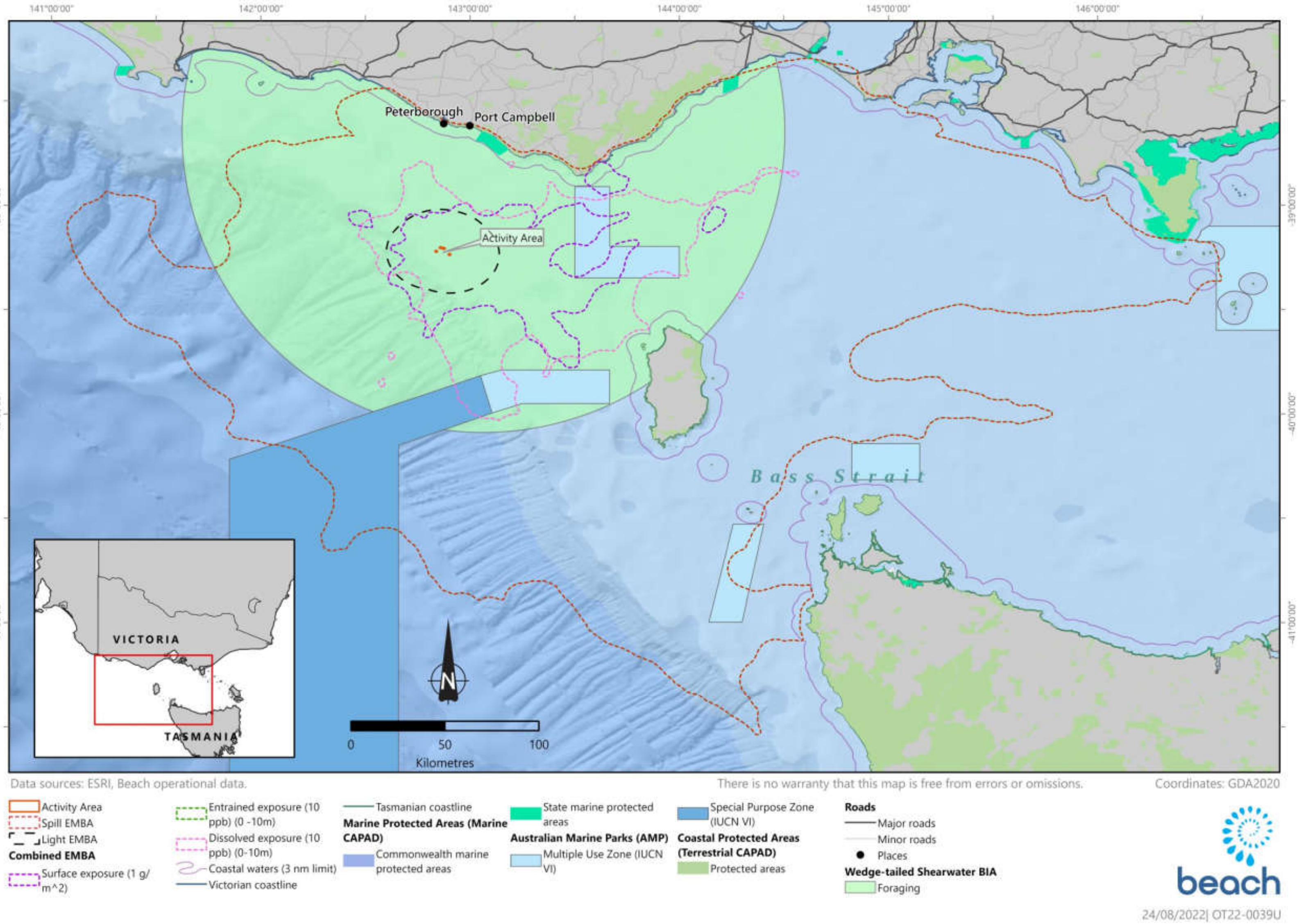


Figure 5-26: BIAs for wedge-tailed shearwater

5.5.7.3 Osprey and white bellied sea eagle

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

5.5.7.4 Parrots

The swift parrot (*Lathamus discolour*) is a small parrot that has rapid, agile flight. During summer, it breeds in colonies in blue gum forest of south-east Tasmania. Infrequent breeding also occurs in north-west Tasmania. The swift parrot is known to be vagrant and stage on King Island (Bennett et. al, 2015). The entire population migrates to the mainland for winter. On the mainland it disperses widely and forages on flowers and psyllid lerps in eucalypts. The birds mostly occur on inland slopes, but occasionally occur on the coast (TSSC, 2016). Given its habitat preferences and movement patterns, this species may be present on King Island (within the spill EMBA). And is likely to overfly on its migration to mainland Australia.

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 5-27). 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. However, parrots rarely land or forage out at sea.

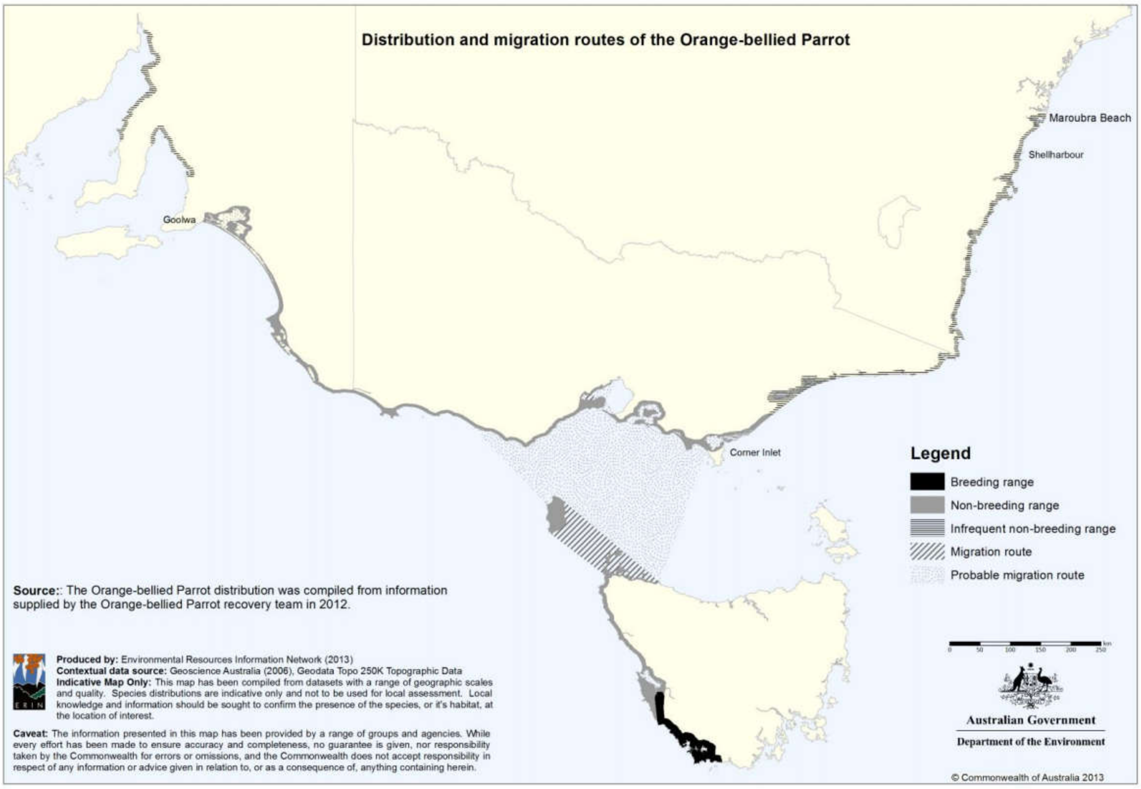


Figure 5-27: Migration routes and breeding ranges for the orange-bellied parrot (DELWP, 2016a)

5.5.7.5 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. BIAs for breeding and foraging, has been identified for the Little Penguin within the spill EMBA (Figure 5-28), including the Phillip Island colony.

Most little penguins stay at sea throughout autumn and winter, although some will return frequently to their burrows all year round. Little penguins breed from August to October, nesting from late September to about late October with incubation through to mid-November while chick raising occurs over the subsequent summer months (Arnould and Berlincourt, 2013; CSIRO, 2000; Gormley and Dann, 2009). Table 5-15 summarises little penguin daily and seasonal behaviour.

Little penguins have an annual breeding cycle that results in their behaviour and activity changing considerably throughout the year. Little penguins are known to travel considerable distance during the non-breeding season and display much shorter foraging behaviour during the chick raising phase of their cycle. During the breeding period, the penguins forage close to the colonies to attend to their chicks daily. By winter the chicks have fledged and the adults have moulted and can undertake foraging trips of extended duration in order to regain the weight lost during the autumn moulting period (CSIRO, 2000; Gormley and Dann, 2009). Little penguins tracked from Phillip Island during the winter were shown to travel hundreds of kilometres and stay away from the colony for periods lasting a couple of weeks. Port Phillip Bay was heavily utilised, suggesting that this area is an important feeding ground for the little penguin (Arnould and Berlincourt, 2013).

There are many little penguin colonies along the Victorian coast and their size varies considerably from six to 35,000 birds at Pyramid Rock and Gabo Island respectively. One of Australia's largest little penguin colonies of approximately 26,000 breeding individuals exist on the Summerland Peninsula, Phillip Island (within the spill EMBA). There are also smaller colonies on rocky islands off Wilsons Promontory, Flinders Island and King Island (Arnould and Berlincourt, 2013). According to a bird study in King Island conducted between 1967-1968, multiple little penguin rookeries were identified. The biggest being two acres located at Fitzmaurice Bay, Councillor Island also supported a large rookery, as well as several smaller ones located on the north coast (Green and McGarvie,1971). The 2015 Tasmanian bird report reinforces this, reporting they were breeding (Bennett et. al, 2015). Little penguin breeding colonies also occur in Port Campbell National Park (Jessop and Du Guesclin, 2000) which is also within the EMBA. It is possible that little penguins will move through the activity area and highly likely that they will forage, breed and travel through the EMBA due to BIAs for foraging and feeding being present.

Table 5-15: Summary of little penguin seasonal behaviour

Behaviour	Description
Residency at nesting sites	All year
Daily cycle to and from shore: - Leaving - Arriving	1 - 2 hr before sunrise Majority (60%) arrive in the first 50 min of sunset, the rest within 2 hours
Feeding	Mainly small fish such as pilchards, anchovies and squid
Swimming speed	1 -4 km per hr
Diving depth	Usually less than 10 m but can dive to 70 m
Underwater time	Usually 4 - 45 seconds
Travel distance each day	15 – 50 km
Mating period	August - October
Egg laying	September - October (on Phillip Island)
Incubation period	35 days
Age when chicks go to sea	8 - 10 weeks after hatching
Moulting	Feb - April for about 17 days - birds remain onshore
Renovation of burrows and courtship	May – August, depending on food supply

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).

5.5.7.6 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 5-29).

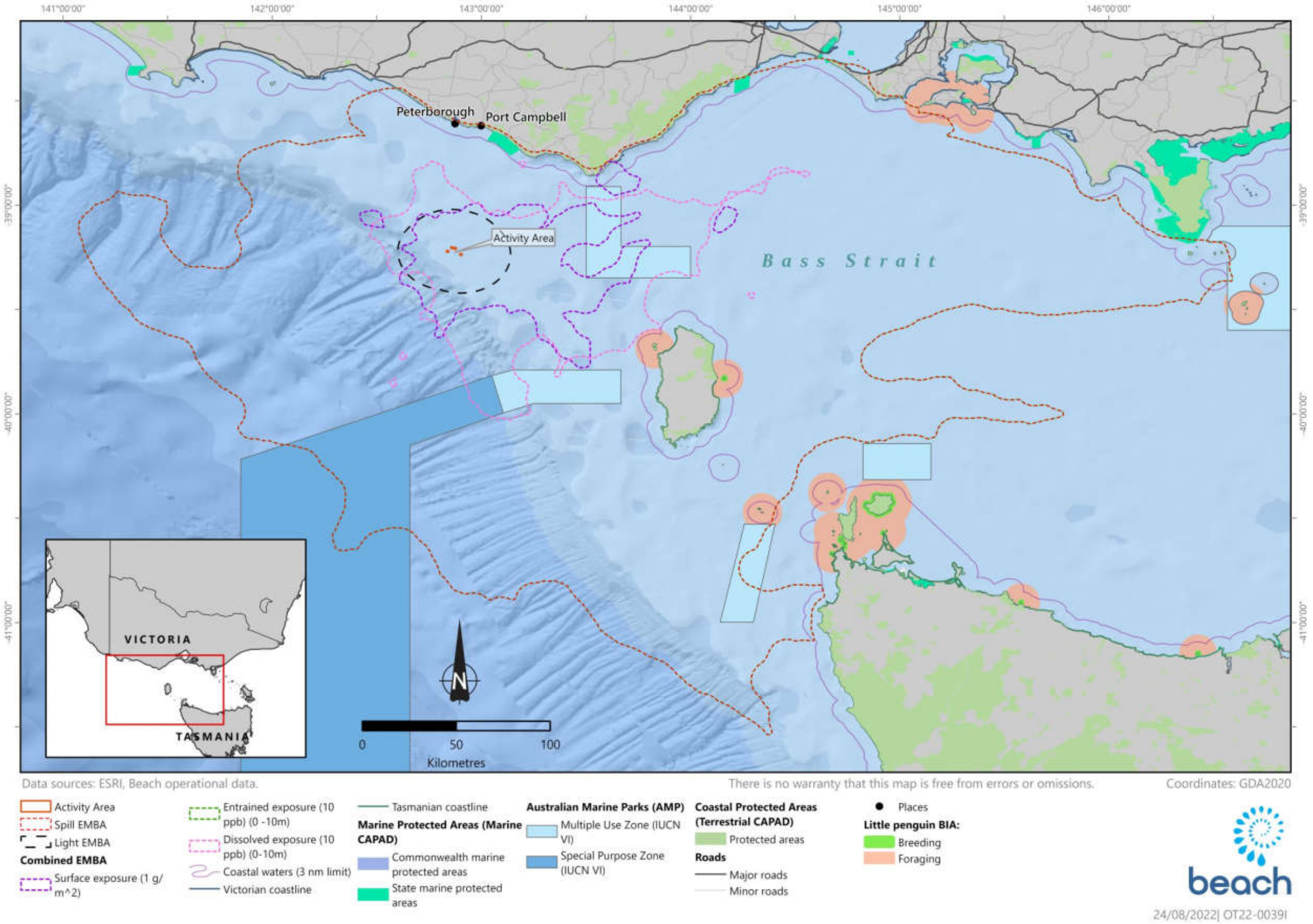


Figure 5-28: BIAs for little penguin

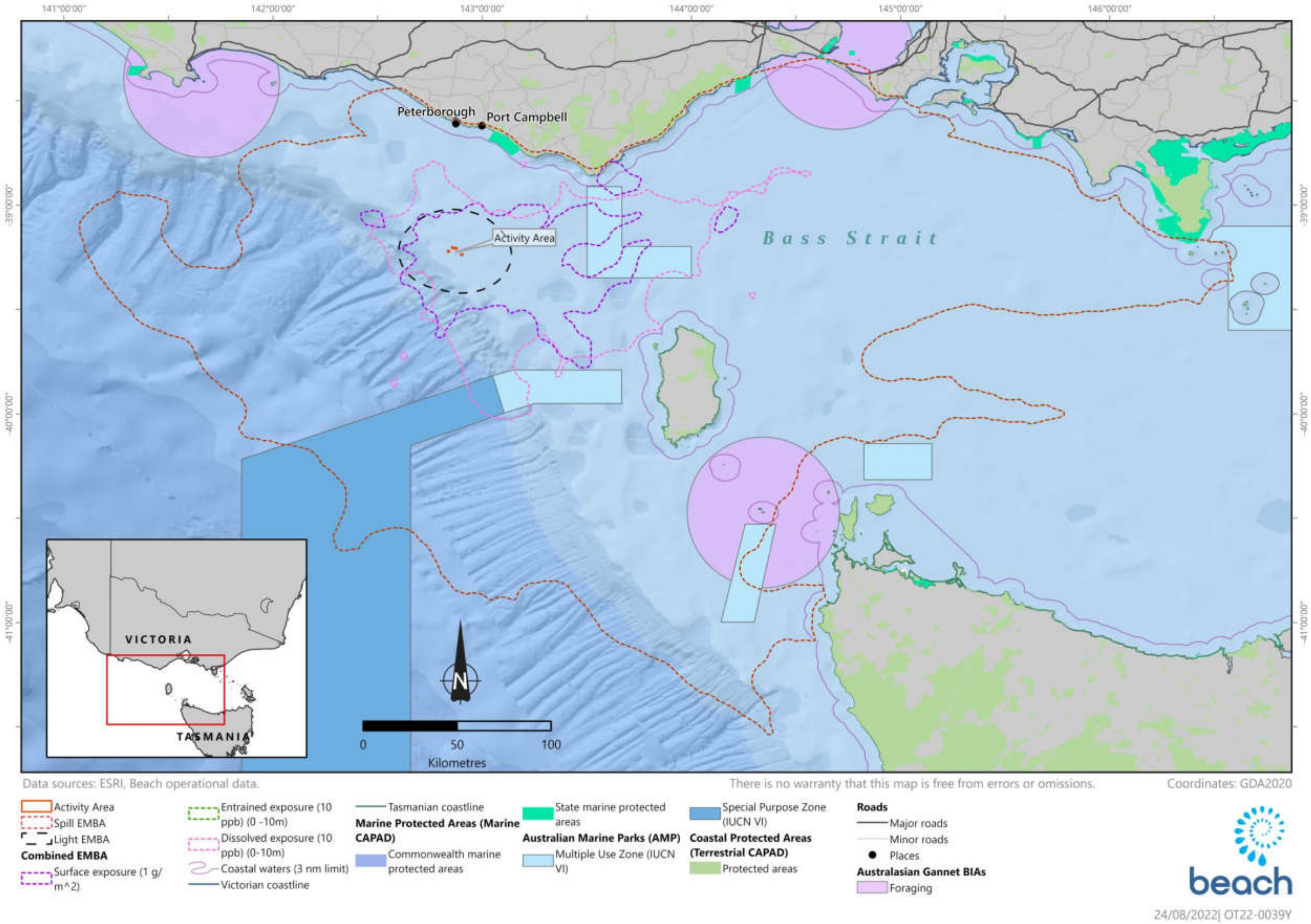


Figure 5-29: BIAs for Australasian gannet

5.5.7.7 Other birds

Southern fairy prion

The southern fairy prion (*Pachyptila turtur subantarctica*) is mainly found offshore. The species diet is comprised mostly of crustaceans (especially krill), but occasionally includes some fish and squid. It feeds mainly by surface-seizing and dipping, but can also catch prey by surface-plunging or pattering (TSSC, 2015a). In Australia, it is known to breed only on Macquarie Island (2,088 km southeast of the activity area), and on the nearby Bishop and Clerk islands (TSSC, 2015a). The southern fairy prion may forage in the waters of the spill EMBA. During the Geographe-4 drilling campaign (April 2021) fairy prior were sighted as present in the area.

Plovers

Plovers feed on a range of molluscs, worms, crustaceans and insects. Plovers (with the exception of the hooded and red-capped plovers) breed in Asia and the Artic region and are present in Australia during the warmer months, depending on the species and its migration pathway. The hooded plover (*Thinornis rubricollis*) and red-capped plover (*Charadrius ruficapillus*) breed in Australia, building their nests in sandy oceanic beaches. The location of these nests presents the greatest threat to this species' population, as nests, eggs and chicks are vulnerable to predation and trampling (DoE, 2014a; Birdlife Australia, 2022). The extensive sandy beaches of the southwest Victorian coast are recognised habitat for the hooded plovers.

Sandpipers

Four of the EPBC Act-listed sandpiper species (common, sharp-tailed, curlew, pectoral) may occur within the spill EMBA. They breed in Europe and Asia and migrate to Australia during the southern summer. Sandpipers are small wader species found in coastal and inland wetlands, particularly in muddy estuaries, feeding on small marine invertebrates (Birdlife Australia, 2020; DoE, 2015b). Up to 3,000 sharp-tailed sandpiper and up to 1,800 curlew sandpiper are known to congregate to feed at the Gippsland Lakes (outside the spill EMBA) (DoE, 2015b). The additional three sandpiper species (broad-billed, marsh and terek) have only been noted within the spill EMBA are also listed as migratory and marine. Sandpipers may be present along shorelines of the spill EMBA depending on the time of year.

Snipes

There are four EPBC-Act listed snipe species that may occur within the spill EMBA (Latham's, Swinhoe's, pin-tailed and Australian painted). These snipe species (other than the Australian painted snipe, which is endemic to Australia) are present during the southern hemisphere summer with breeding in Asia and Russia in the northern hemisphere summer). They are medium-sized waders that roost among dense vegetation around the edge of wetlands during the day and feed at dusk, dawn and during the night on seeds, plants, worms, insects and molluscs. There are few confirmed records of the pin-tailed and Swinhoe's snipe in Victoria (Birdlife Australia, 2022), while the Australian painted snipe is known to occur at Mallacoota Inlet (outside the spill EMBA) (DSEWPC 2013a). Snipes may be present along shorelines of the spill EMBA depending on the time of year.

Curlews

The two EPBC Act-listed curlews (eastern and little) are medium-sized migratory birds that breed in the far north of Siberia and winters in Australasia. The eastern curlew (*Numenius madagascariensis*) is the world's largest shorebird and is widespread in coastal regions in the north-east and south of Australia, including Tasmania. It is commonly found on intertidal mudflats and sandflats where it uses its long beak to pick the surface and probes for crabs. Curlews are also found on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons (DoE, 2015c)

The eastern curlew was amended from endangered to critically endangered in 2015 because research shows population decline potentially caused by wetland reclamation in some areas of Asia. In Victoria, the main strongholds are in Corner Inlet (301 km northeast from the activity area, outside the spill EMBA) and Westernport (225 km northeast from the activity area, outside the spill EMBA), with smaller populations in Port Phillip Bay and scattered elsewhere along the coast. Eastern curlews are found on islands in Bass Strait and along the northwest, northeast, east and southeast coasts of Tasmania. Historically, sightings have been recorded in Bass Strait and depending on the time of year eastern curlews may be present in the coasts of the spill EMBA (DoE, 2015c).

The little curlew breeds in Siberia and is seen on passage through Mongolia, China, Japan, Indonesia and New Guinea. In Australia, the little curlew is a bird of coastal and inland plains of the north where it often occurs around wetlands and flooded ground. They often form large flocks, occasionally comprising thousands of birds and sometimes associate with other insectivorous migratory shorebirds. Given the little curlew is present in Queensland and the Northern Territory but not in Victoria, it is unlikely to be encountered in the activity area or the spill EMBA (Birdlife Australia, 2020).

Godwits

Godwits are large waders that are found around all coastal regions of Australia during the southern hemisphere summer (breeding in Europe during the northern hemisphere summer), though the largest numbers remain in northern Australia. Godwits are commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit where they forage on intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries (Birdlife Australia, 2022). They have been recorded eating annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs, and occasionally seeds. Three species of Godwits were reported (bar-tailed, Nunivak and black-tailed) within the spill EMBA. Both the bar-tailed and black-tailed godwits are listed as marine and migratory. The black-tailed godwit has not been recorded in King Island; only within limited coastal areas of Victoria and Tasmania (DAWE, 2022b). The Nunivak godwit (*Limosa lapponica baueri)* which is a subspecies of the bar-tailed was listed as vulnerable in 2016 and is known to occur in coastal areas of King Island, Victoria and Tasmania (same as the bar-tailed) (within the spill EMBA) (DAWE, 2022b). The Nooramunga Marine and Coastal Park (outside the EMBA) has recorded the largest concentrations of bar-tailed godwit (*Limosa lapponica*) in south-eastern Australia. Due to the species distribution and abundance, they may be present in the spill EMBA

Knots

Two Knot species have been identified within the PMST report (red and great). Knots are a medium-sized waders that prefer sandy beach, tidal mudflats and estuary habitats, where they feed on bivalve molluscs, snails, worms and crustaceans (Birdlife Australia, 2022). The red knot (*Calidris canutus)* is listed as endangered and was recorded in both the activity area and the spill EMBA. The red knot has a coastal distribution around the entire Australian coastline (including King Island), when they are present during the southern hemisphere summer (breeding in eastern Siberia in the northern hemisphere summer). Lake Reeve (outside the spill EMBA) has supported the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria. The great knot (*Calidris tenuirostris*) is listed as critically endangered and was only reported within the spill EMBA. The biggest populations have been found in the northern coast of Australia, with only fragmented locations along the southern coast (TSSC, 2016). Although the distribution of the great knot is sparse within Victoria, it is possible that it will be present in some coastal areas of the spill EMBA. The red knot will likely be present within both the activity area and spill EMBA due to its habitat preferences and distribution.

Australasian bittern

The Australasian bittern (*Botaurus poiciloptilus*) is a large, stocky, heron-like bird that occurs from southeast Queensland to southern South Australia, and Tasmania (including King Island). In Victoria, the species is mainly found in coastal areas and the Murry River region of central Victoria (TSSC, 2019). The Australasian bittern occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands (TSSC, 2019). The species is threatened by the clearing and modification of wetlands for urban and agricultural development, as well as the extraction of water from wetlands for irrigation (TSSC, 2019). The Australasian bittern may be present in the spill EMBA due to its coastal presence within Victoria and King Island.

Waders

Other waders including common noddy, 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 activity 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.

5.5.8 Marine reptiles

The PMST reports for the activity area and spill EMBA identified three marine turtle species likely to occur (Table 5-16, Appendix B). 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 activity area or spill EMBA.

5.5.8.1 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.

5.5.8.2 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.

5.5.8.3 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 5-16: Listed turtle species identified in the PMST

Common name	Species name	EPBC Act listing status			Spill EMBA	Activity area (1 km)
		Threatened	Migratory	Marine		
Green turtle	*Chelonia mydas*	V	M	L	SHM	SHM
Leatherback turtle	*Dermochelys coriacea*	E	M	L	FK	SHL
Loggerhead turtle	*Caretta caretta*	E	M	L	FK	SHL

Listed Threatened
E: Endangered
V: Vulnerable
Listed Migratory
M: Migratory
Listed Marine
L: Listed

Likely Presence
FK: Foraging, feeding or related behaviour likely to occur within area
SHL: Species or species habitat likely to occur within area
SHM: Species or species habitat may occur within area

5.5.9 Cetaceans

The PMST reports identified several cetaceans that potentially occur in the activity area and spill EMBA (Appendix B). Table 5-17 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 activity 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 5.5.9.2).

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 5-18 and Table 5-19). 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 5-21 provides this cetacean sighting data. For whales, the highest number of detections was for blue whales (198), while for dolphins, it was the common dolphin (519). Further detail on marine fauna observations of blue whales through to 30 April 2022 is provided in Section 5.5.9.2 (The Otway Region).

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 (see Section 5.3.10.2), 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.

Table 5-17: Listed cetacean species identified in the PMST report

Common name	Species name	EPBC Act listing status			Spill EMBA	Activity area (1 km)	Recovery plan?
		Threatened	Migratory	Marine			
Whales							
Minke whale	*Balaenoptera acutorostrata*	-	-	L	SHM	SHM	
Antarctic minke whale	*Balaenoptera bonaerensis*	-	M	L	SHL		
Sei whale	*Balaenoptera borealis*	V	M	L	FK	FL	CA
Blue whale	*Balaenoptera musculus*	E	M	L	FK	FK	RP
Fin whale	*Balaenoptera physalus*	V	M	L	FK	FL	CA
Arnoux's beaked whale	*Berardius arnuxii*	-	-	L	SHM	SHM	
Pygmy right whale	*Caperea marginata*	-	M	L	FL	FM	
Southern right whale	*Eubalaena australis* *Balaena glacialis australis*	E	M	L	BK	SHK	CMP
Short-finned pilot whale	*Globicephala macrorhynchus*	-	-	L	SHM	SHM	
Long-finned pilot whale	*Globicephala melas*	-	-	L	SHM	SHM	
Pygmy sperm whale	*Kogia breviceps*	-	-	L	SHM	SHM	
Dwarf sperm whale	*Kogia simus*	-	-	L	SHM	SHM	
Humpback whale	*Megaptera novaeangliae*	-	M	L	SHK	SHL	
Andrew's beaked whale	*Mesoplodon bowdoini*	-	-	L	SHM	SHM	
Blainville's beaked whale	*Mesoplodon desirostris*	-	-	L	SHM	SHM	
Gray's beaked whale	*Mesoplodon grayi*	-	-	L	SHM		
Hector's beaked whale	*Mesoplodon hectori*	-	-	L	SHM	SHM	
Strap-toothed beaked whale	*Mesoplodon layardii*	-	-	L	SHM	SHM	
True's beaked whale	*Mesoplodon mirus*	-	-	L	SHM	SHM	
Killer whale, orca	*Orcinus orca*	-	M	L	SHL	SHL	
Sperm whale	*Physeter macrocephalus*	-	M	L	SHM	SHM	

Common name	Species name	EPBC Act listing status			Spill EMBA	Activity area (1 km)	Recovery plan?
		Threatened	Migratory	Marine			
False killer whale	*Pseudorca crassidens*	-	-	L	SHL	SHL	
Shepherd's beaked whale	*Tasmacetus shepherdi*	-	-	L	SHM		
Curvier's beaked whale	*Ziphius cavirostris*	-	-	L	SHM	SHM	
Dolphins							
Common dolphin	*Delphinus delphis*	-	-	L	SHM	SHM	
Risso's dolphin	*Grampus griseus*	-	-	L	SHM	SHM	
Dusky dolphin	*Lagenorhynchus obscures*	-	M	L	SHL	SHM	
Southern right whale dolphin	*Lissodelphis peronii*	-	-	L	SHM	SHM	
Indian ocean bottlenose dolphin	*Tursiops aduncus*	-	-	L	SHL		
Bottlenose dolphin	*Tursiops truncates*	-	-	L	SHM	SHM	

Listed Threatened
- E: Endangered
- V: Vulnerable

Listed Migratory
- M: Migratory

Listed Marine
- L: Listed

Likely Presence
- SHM: Species or species habitat may occur within area.
- SHL: Species or species habitat likely to occur within area.
- SHK: Species or species habitat known to occur within area.
- FK: Foraging, feeding or related behaviour known to occur within area. FL: Foraging, feeding or related behaviour likely to occur within area
- FM: Foraging, feeding or related behaviour may to occur within area.

Table 5-18: Cetacean species recorded during aerial surveys 2002–2013 in southern Australia

Taxon	Common name	Species group*	Sightings	Individual	Mean group size (+/- SD)
Baleen whales					
Eubalaena australis	Southern right whale	SRW	12	52	4.2 +/- 4.2
Caperea marginata	Pygmy right whale		1	100	100
Balaenoptera physalus	Fin and like fin whale	ROR	7	8	1.1 +/- 0.4
B. borealis	Sei and like sei whale	ROR	12	14	1.3 +/- 0.5
B. acutorostrata	Dwarf minke whale	ROR	1	1	1
B. bonaerensis	like Antarctic minke whale	ROR	1	1	1
Megaptera novaeangliae	Humpback whale	ROR	10	18	1.8 +/- 1.0
Toothed whales					
Physeter macrocephalus	Sperm whale	ODO	34	66	1.9 +/- 2.2
Mesoplodon spp.	Unidentified beaked whales	ODO	1	20	20
Orcinus orca	Killer whale	ODO	6	21	3.5 +/- 2.8
Globicephala melas	Long-finned pilot	ODO	40	1,853	46.3 +/- 46.7
Grampus griseus	Risso's dolphin	ODO	1	40	40
Lissodelphis peronii	Southern right whale dolphin	ODO	1	120	120
Tursiops spp.	Bottlenose dolphin	DOL	4	363	90.8 +/- 140.1
	Dolphins	DOL	384	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 5-19: Temporal occurrence of cetacean sightings during aerial surveys from November 2002 to March 2013

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. Sightings/1,000 km survey distance/month, pooled for all years (i.e. the period from Oct–Sep).

Table 5-20: 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 surveys

Table 5-21: Marine fauna observations at project locations during the Otway drilling project in 2021

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

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

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

5.5.9.2 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 activity area and spill EMBA (Figure 5-30).

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 (35–45^0 South, 115–125^0 East) (Commonwealth of Australia, 2015b).

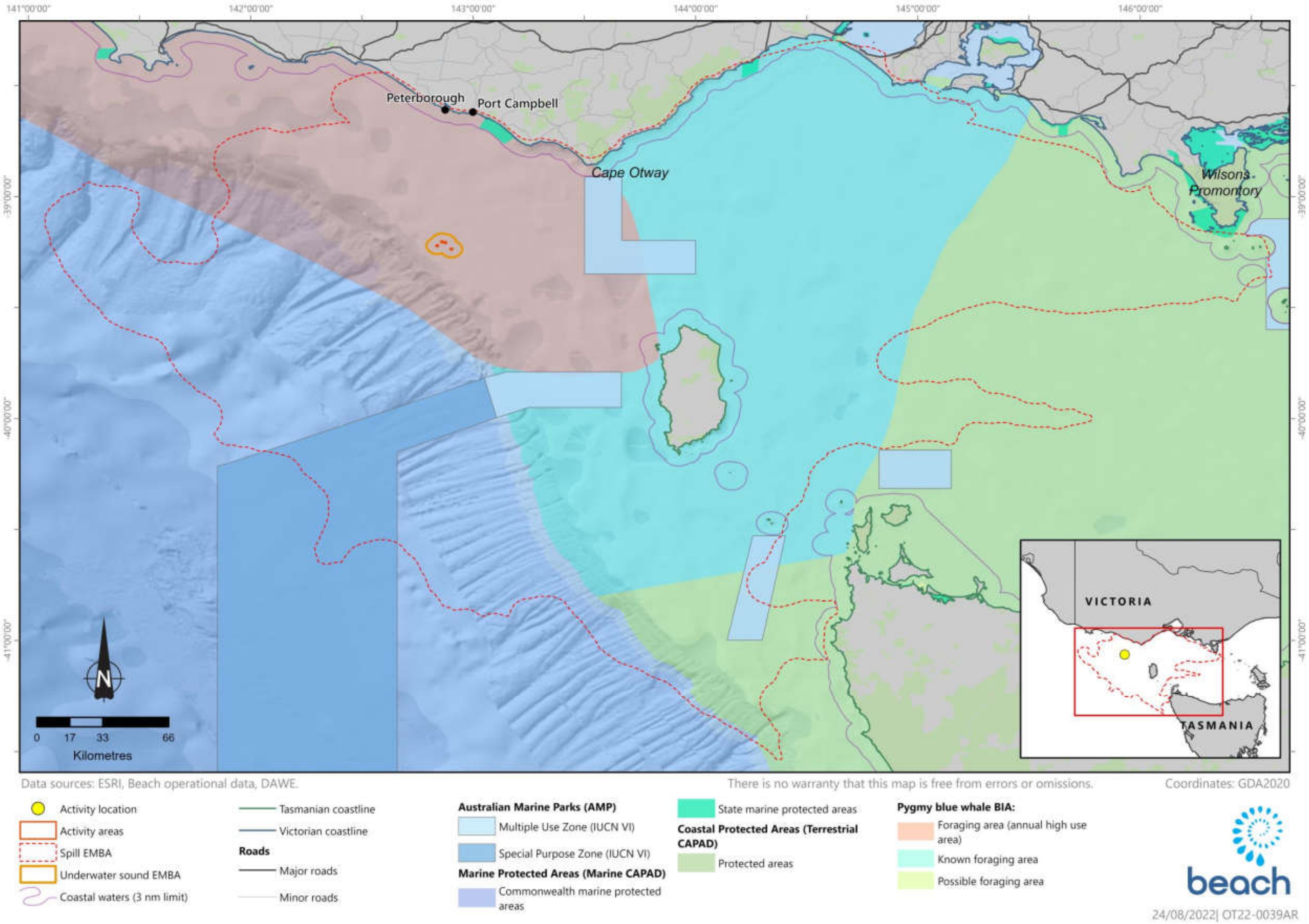


Figure 5-30: BIA for the pygmy blue whale within the spill EMBA

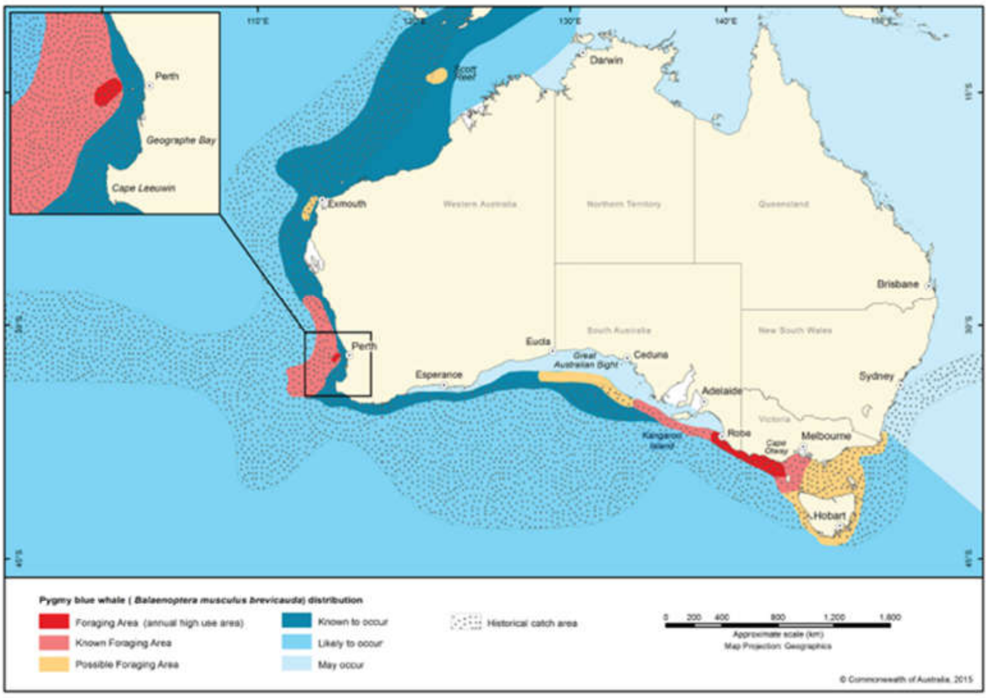
Distribution

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 5-31. 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).



Foraging Area (Annual high use area)	Blue whales are regularly observed feeding on a seasonal basis
Known Foraging Area	Known foraging occurs in these areas but is highly variable both between and within seasons
Possible Foraging Area	Evidence for feeding is based on limited direct observations or through indirect evidence, such as occurrence of krill in close proximity of whales, or satellite tagged whales showing circling tracks. Blue whales travel through on a seasonal basis, possibly as part of their migratory route

Known to occur	Blue whales are known to occur based on direct observations, satellite tagged whales or based on acoustic detections
Likely to occur	Blue whales are likely to occur based on occasional observations in the area and nearby areas
May occur	Evidence for the presence of blue whales through strandings or rare observations
Historical catch area	Blue whales were caught during the whaling period based on whaling data

Figure 5-31: 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). Blue whales typically feed during daylight hours when krill is visible to them (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 5-31). 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.

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 5-32 and Figure 5-33).

The sighting and effort data presented in Figure 5-32 and Figure 5-33 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 activity area on the outer edge of the eastern area.

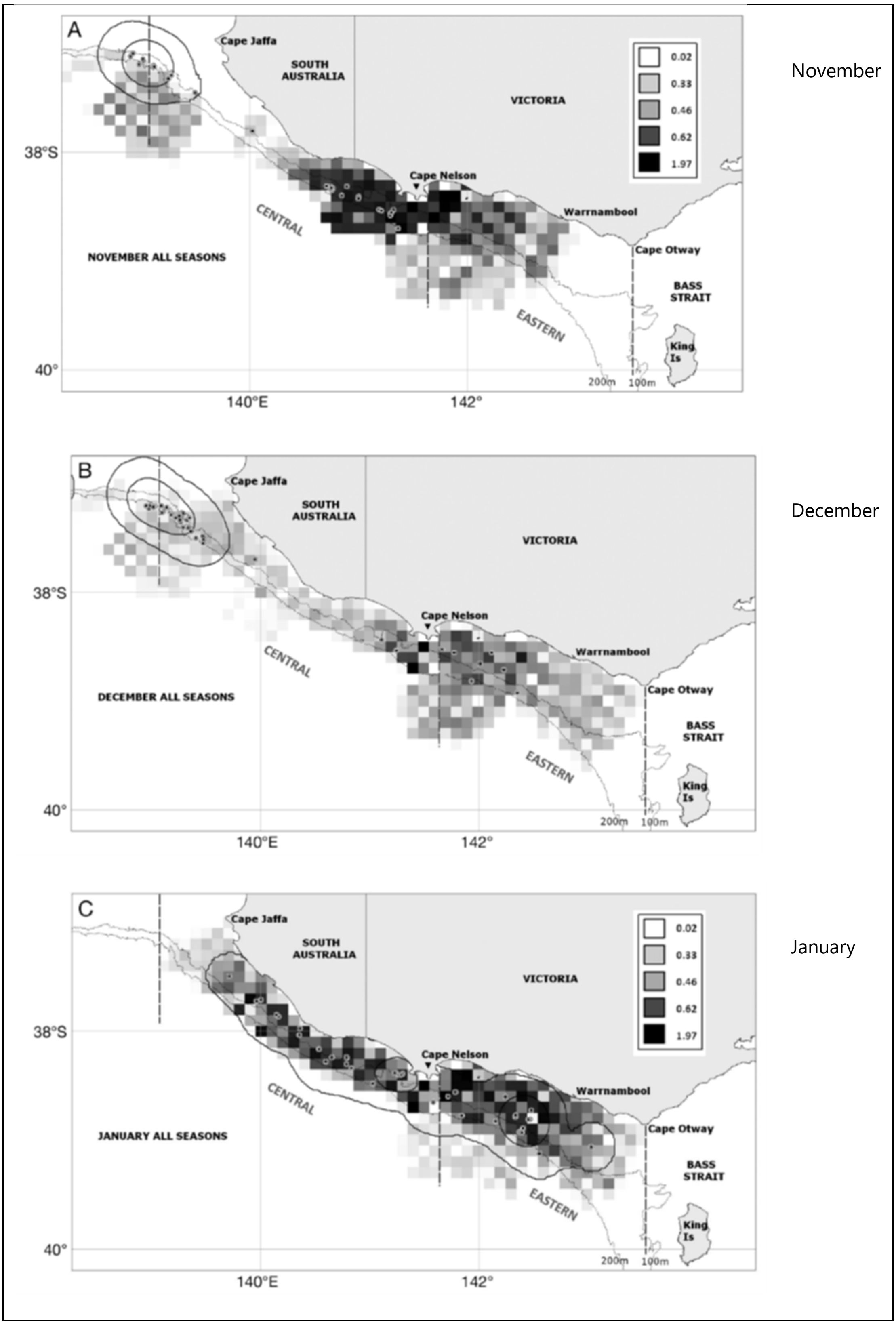


Figure 5-32: Blue whale sightings between 2001 and 2007 in the Otway Basin (Nov, Dec, Jan) (Gill et al., 2011)

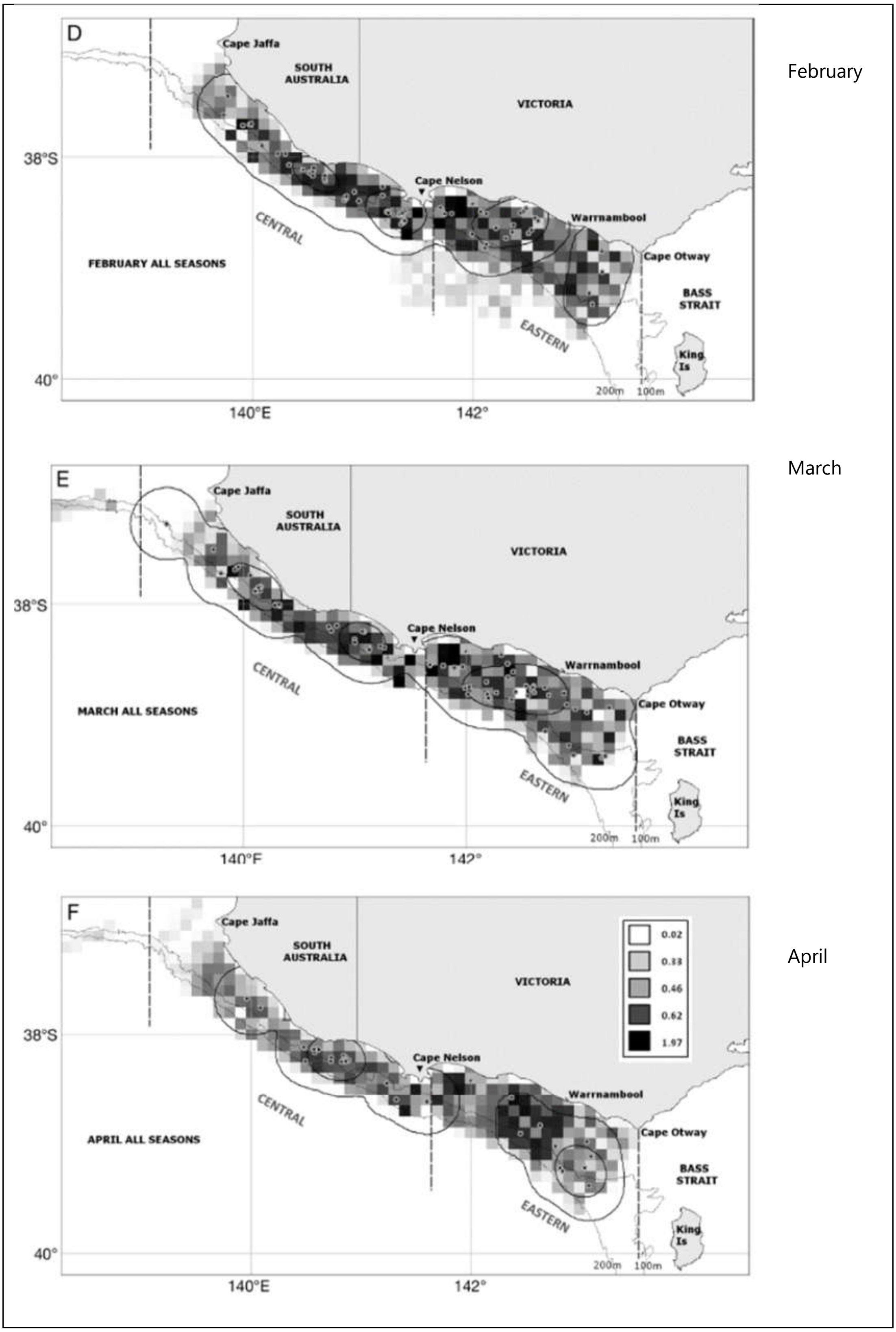


Figure 5-33: Blue whale sightings between 2001 and 2007 in the Otway Basin (Feb, Mar, Apr) (Gill et al., 2011)

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 5-34. 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 5-32).

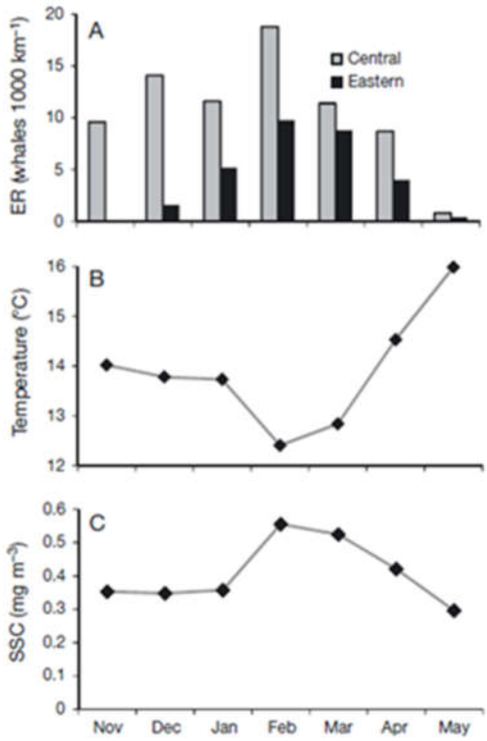


Figure 5-34: Blue whale encounter rates in the central and eastern study area by month (Gill et al., 2011)

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 5-35 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 5-35 and Figure 5-36. 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).

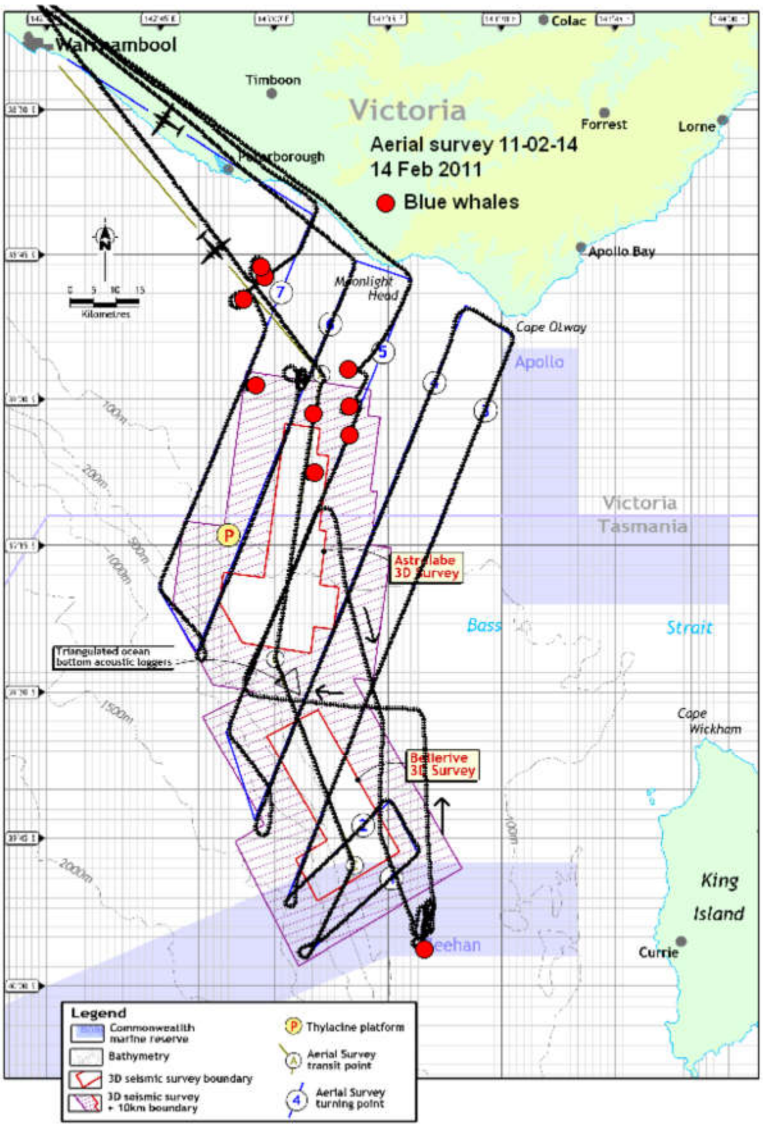


Figure 5-35: Blue whale sightings during an aerial survey for Origin Energy in February 2011 (Gill 2020).

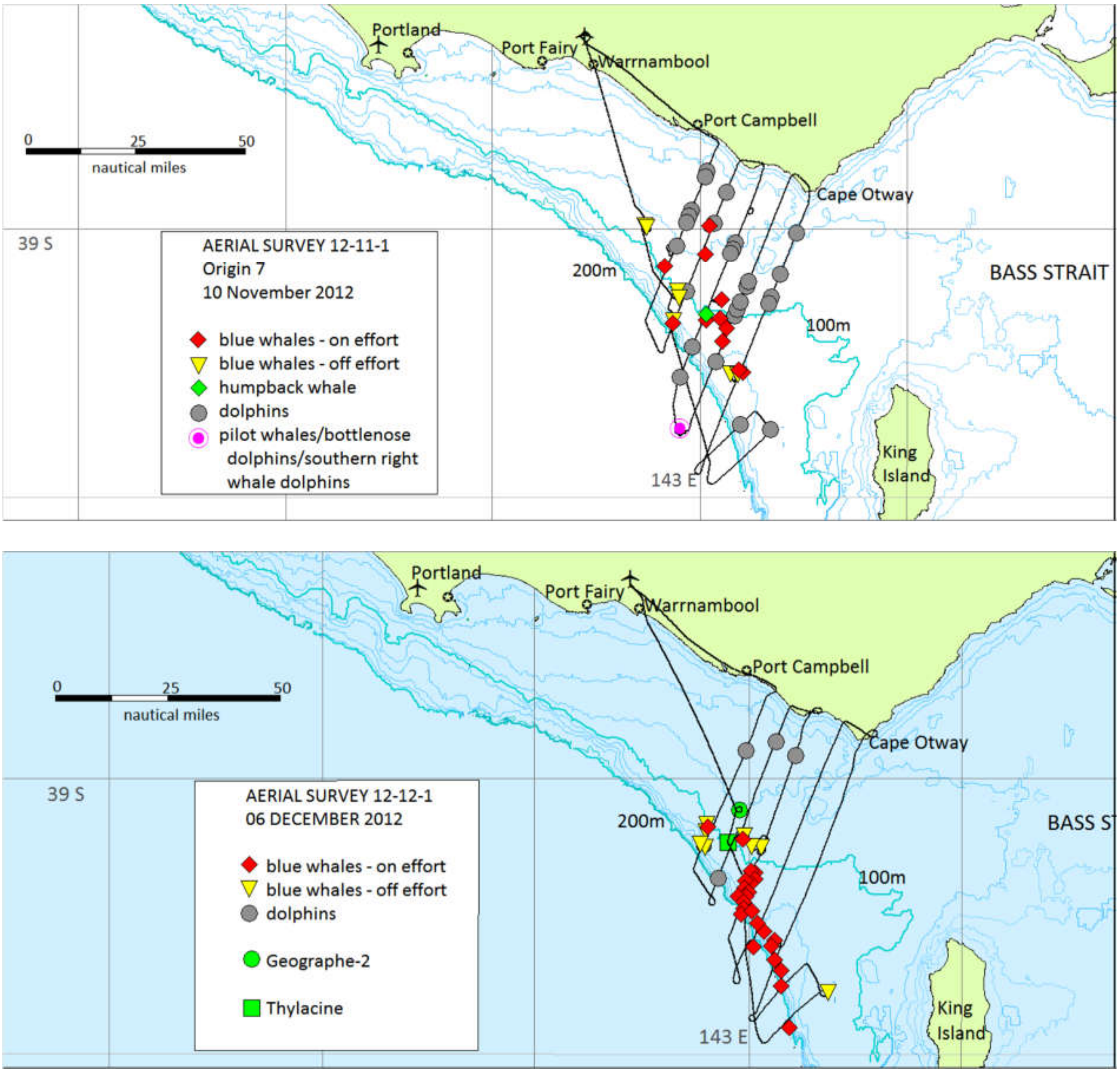


Figure 5-36: Blue whale sightings during an aerial survey for Origin Energy in November and December 2012 (Gill 2020).

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 5-37). 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.

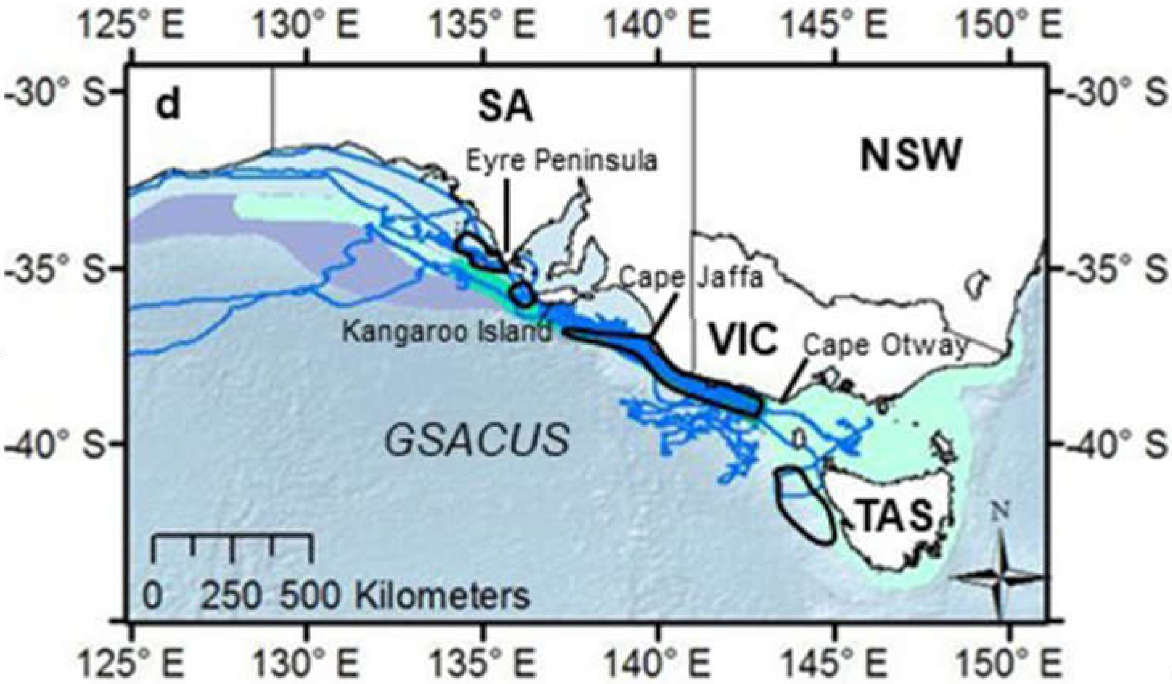


Figure 5-37: Tracks of 13 pygmy blue whales in the GSACUS (Möller et al. 2020)

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 5-38). 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 in increase yearly with whale population growth.

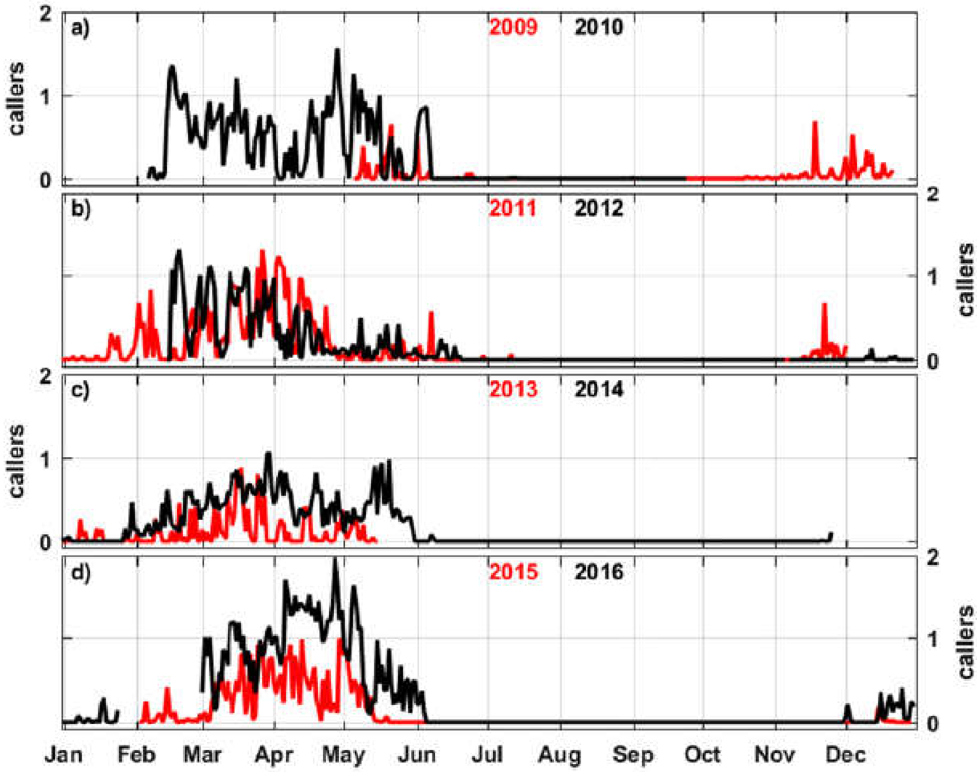


Figure 5-38: Mean number of individual pygmy blue whales calling (McCauley et al. 2018)

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

- Nine aerial surveys were undertaken from 25 February to 21 May 2021.
- There were 34 blue whale sightings consisting of 43 individuals.
- The highest number of blue whale sightings was on 7 April, with 19 blue whales sighted.
- The first blue whale was sighted 25 February and 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 5-39), 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 5-40 shows all whale sightings by MFOs between 2 February 2021 and 31 March 2022 across all well locations. Figure 5-41 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.

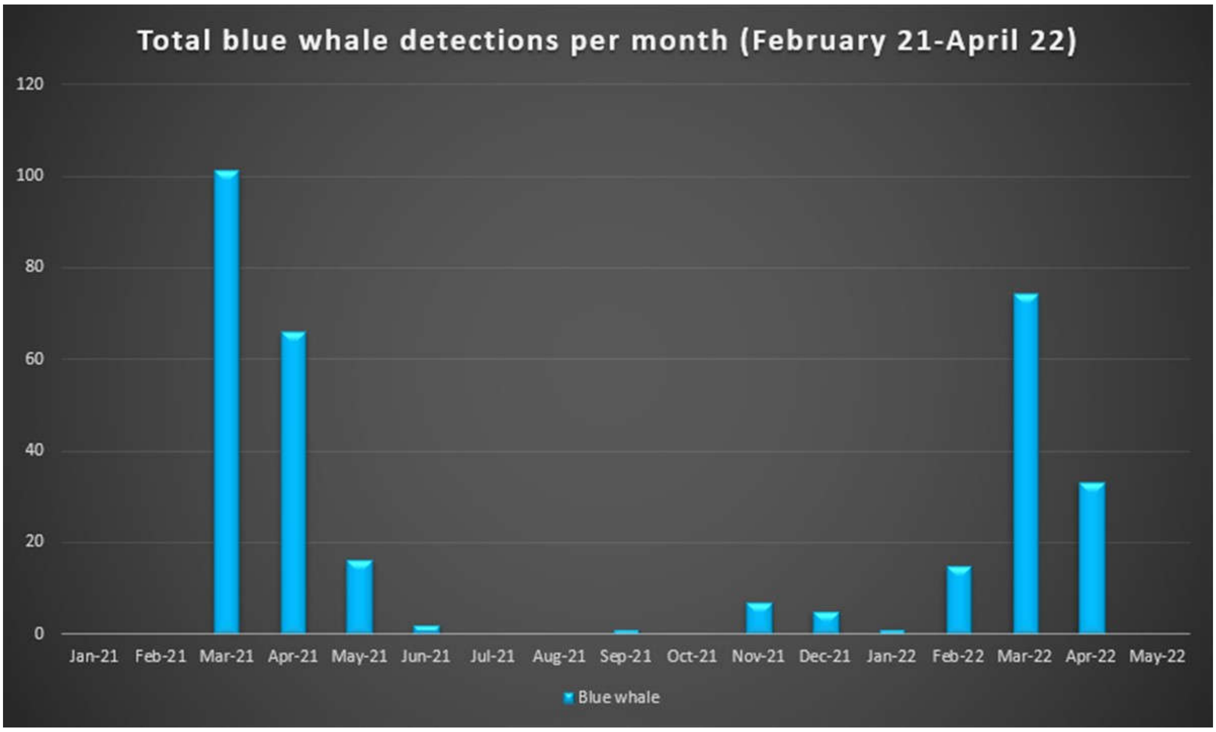


Figure 5-39: Blue whale observations during the Otway Offshore Drilling Campaign

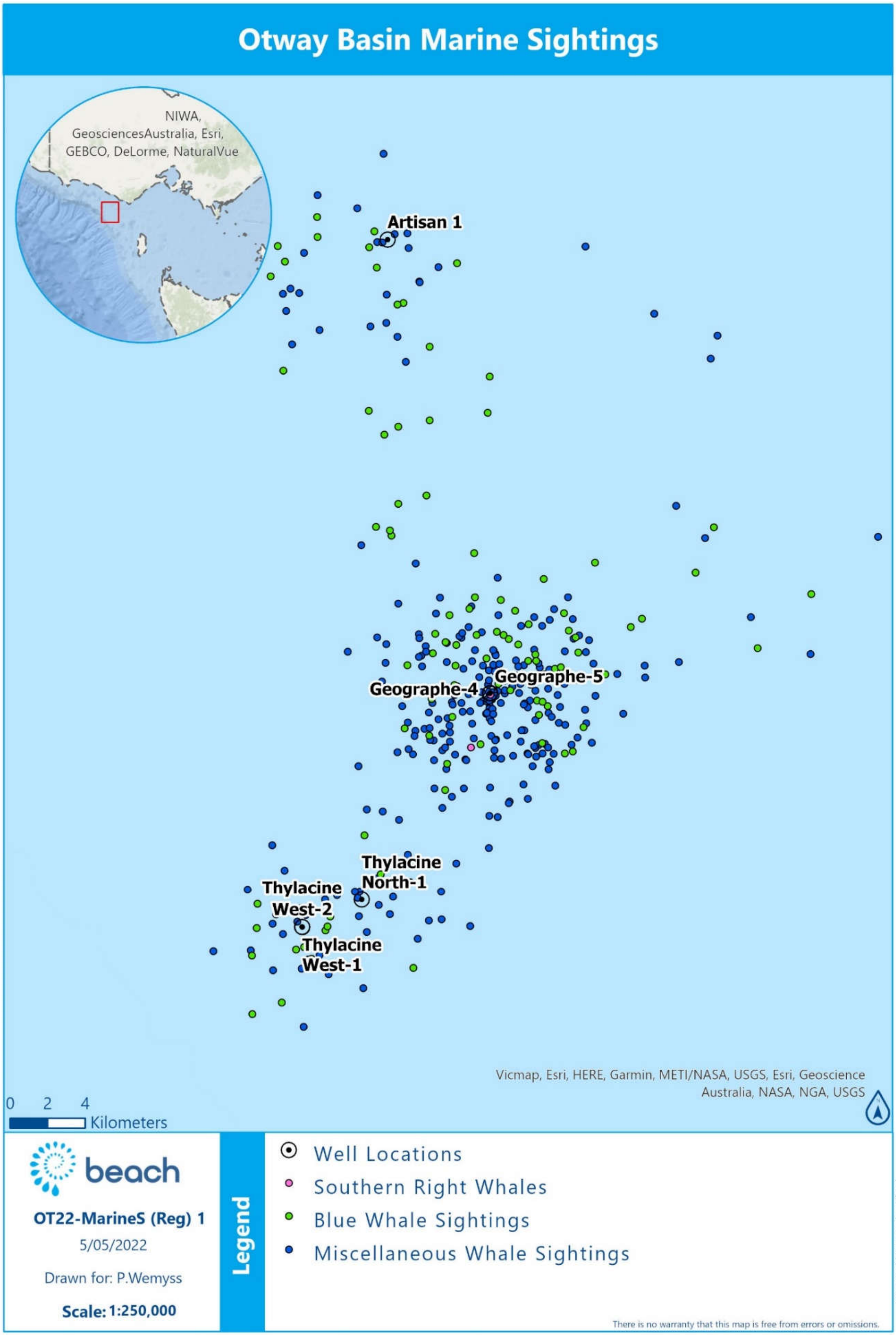


Figure 5-40: Whale sightings between 2 February 21 – 31 March 22

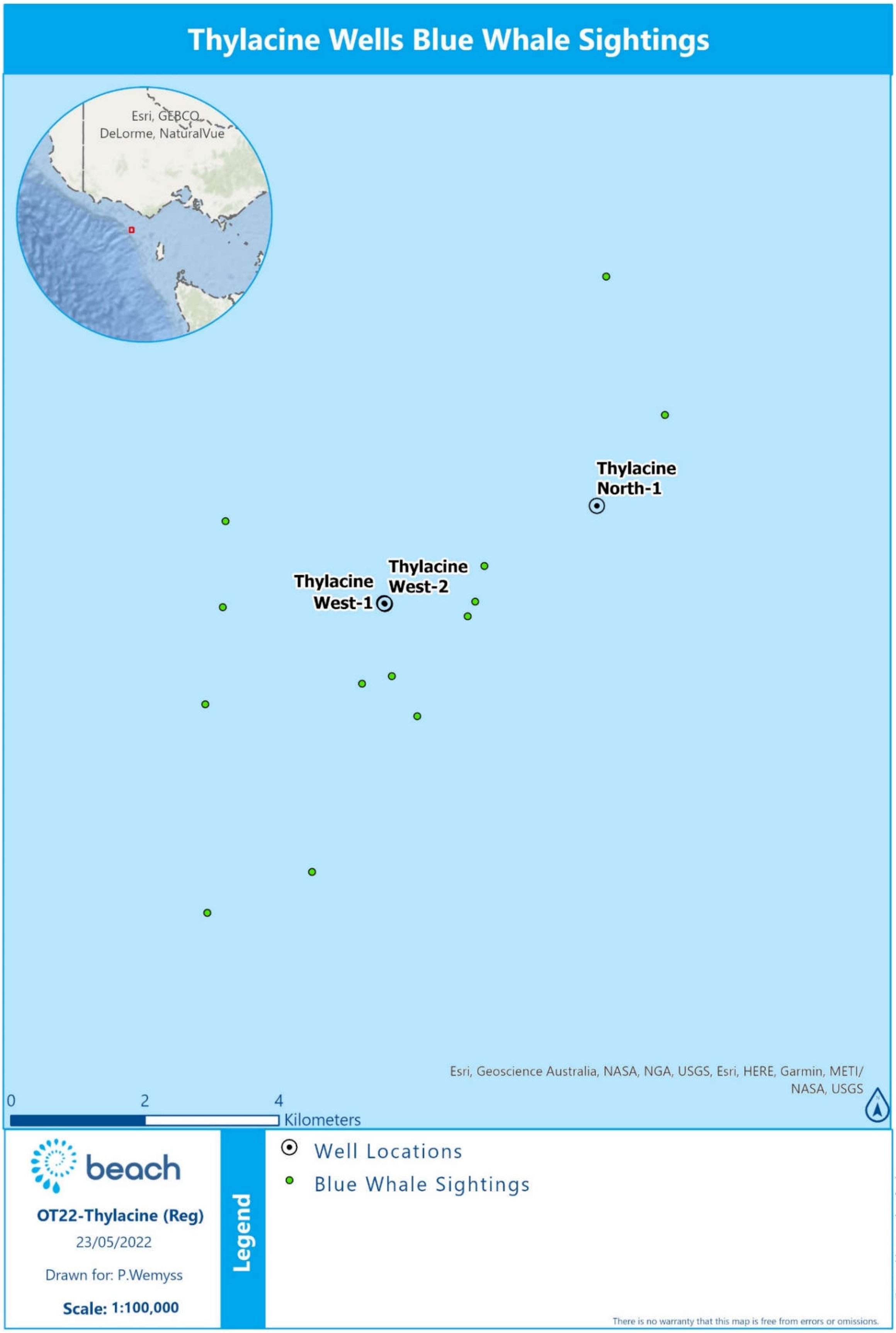


Figure 5-41: Blue whale sightings in the Thylacine field TN-1 (16 Nov 21 – 11 Jan 22); TW (23 Jan 22 – 31 Mar 22)

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 5-22). Thirty-two whales were first detected within 1,500 m of the MODU. Sixty-two were first detected at 1,501 to 3,000 m. Thirty-three were first observed to be further than 3 km from the MODU before moving towards it. The total number of blue whales observed to move towards the MODU (following first detection) was 70 (55%); 57 were observed to move away from the MODU (45%).

Of the 94 whales first detected within 3,000 m of the MODU, 32 were observed within 1,500 m and 62 observed between 1,501 and 3,000 m. The number of blue whales/km^2 observed was 2.7x higher in the 0-1,500 m zone (7.8 whales/km^2) than in the 1,501 to 3,000 m zone (2.9 whales/km^2) (Table 5-22).

Table 5-22: 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/km^2 would be the same in all zones if underwater noise was not displacing blue whales from the area. Alternatively, if whales are being displaced then it would be expected that the number of blue whales/km^2 would increase with increasing distance from the MODU. The apparent increased density of whales within 1,500 m of the MODU in Table 5-22 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 5-42 shows the detection function for all data; Figure 5-43 shows the detection functions under different visibility conditions; Figure 5-44 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).

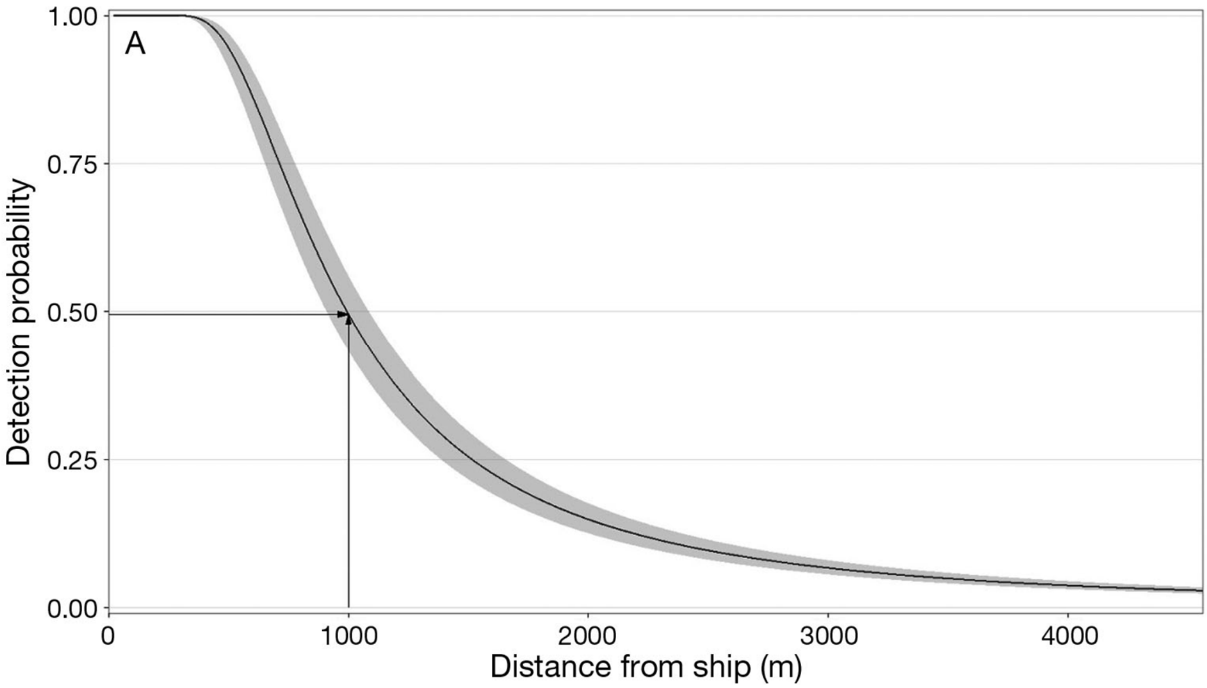


Figure 5-42: Detection probability as it varies with distance between ships and whales in and near Glacier Bay National Park from 2008 to 2015 (Williams et al. 2016)

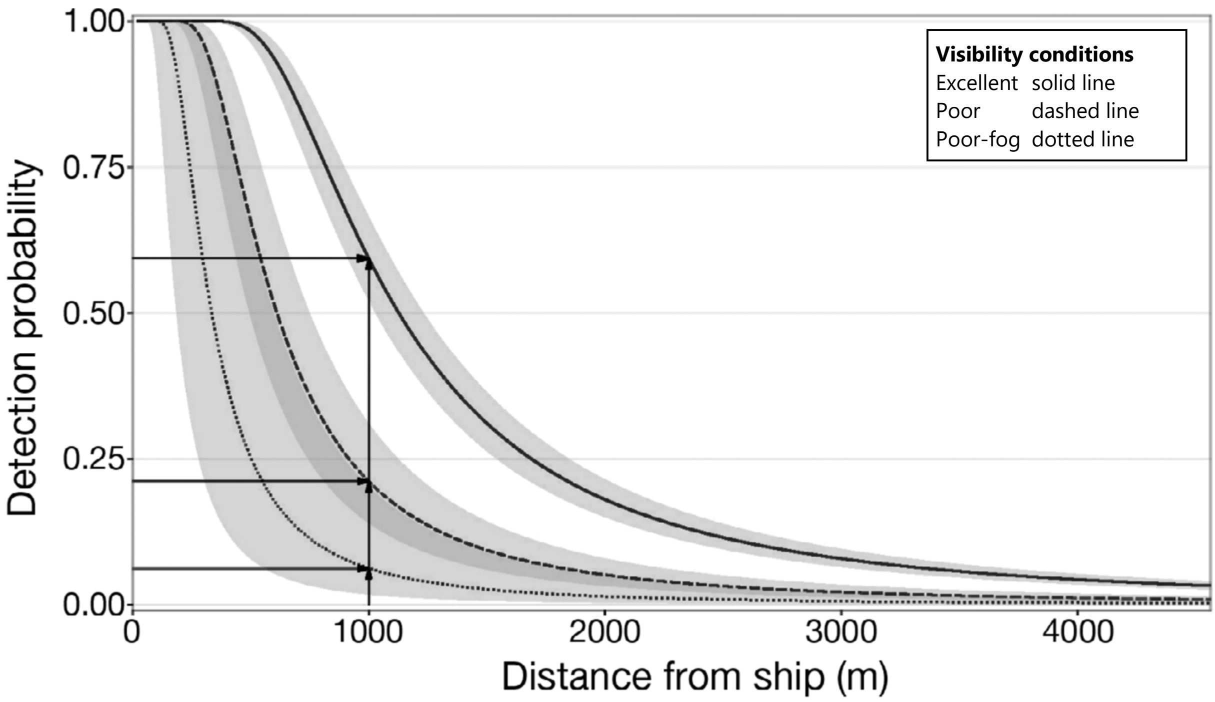


Figure 5-43: Detection probability of humpback whales under different visibility conditions (Williams et al. 2016)

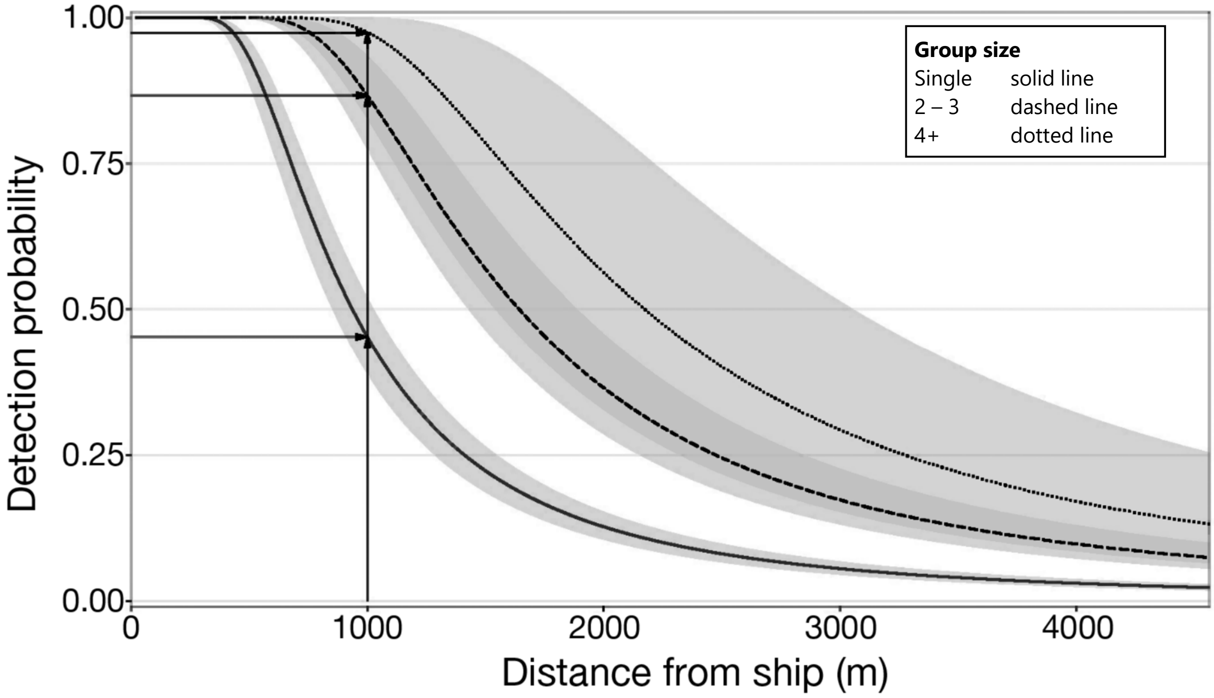


Figure 5-44: Probability of detecting whale groups of different sizes of humpback whales (Williams et al. 2016)

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 5-44. Detection probabilities for this case, along with those for 'excellent visibility' conditions (Figure 5-43) and 'all' data (Figure 5-42) were extracted to provide probabilities in 500 m increments (Table 5-23). To allow these probabilities to be applied to the management zones shown in

Table 5-22 the average probability for each management zone was calculated and expected numbers and densities calculated for the three scenarios (Table 5-24).

Table 5-23: Detection probabilities derived from Williams et al. (2016)

	Derived detection probabilities		
Distance	**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 5-24: Estimated blue whale abundance and density based on MFO data from 2 Feb. 2021 and 31 Mar. 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 5-22				
Observed numbers (b)	6	26	26	36
Blue whales/km^2	7.1	4.1	4.7	2.3
Mean detection probability (c)				
4+ group size	1.00	0.92	0.68	0.42
Excellent visibility	0.99	0.63	0.25	0.13
All data	0.97	0.56	0.20	0.10
Expected numbers (b ÷ c)				
4+ group size	6.0	28.4	38.5	85.7
Excellent visibility	6.1	41.5	106.1	284.2
All data	6.2	46.2	130.0	348.4
Expected density (whales/km^2) (b ÷ c ÷ a)				
4+ group size	7.89	4.50	7.00	5.46
Excellent visibility	7.97	6.58	19.29	18.10
All data	8.14	7.31	23.64	22.19

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 5-45. 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/km^2 across all zones, which (if correct) should apply to the wider area beyond observations. If whales are being displaced beyond 1,500 m as implied by the 'excellent visibility' and 'all data' scenarios, then the minimum mean expected densities for the wider area should be calculated using the observations between 1,501 and 3,000 m. These expected minimum mean densities are 18.70 blue whales/km^2 and 22.91 blue whales/km^2 for the 'excellent visibility' and 'all data' scenarios, respectively.

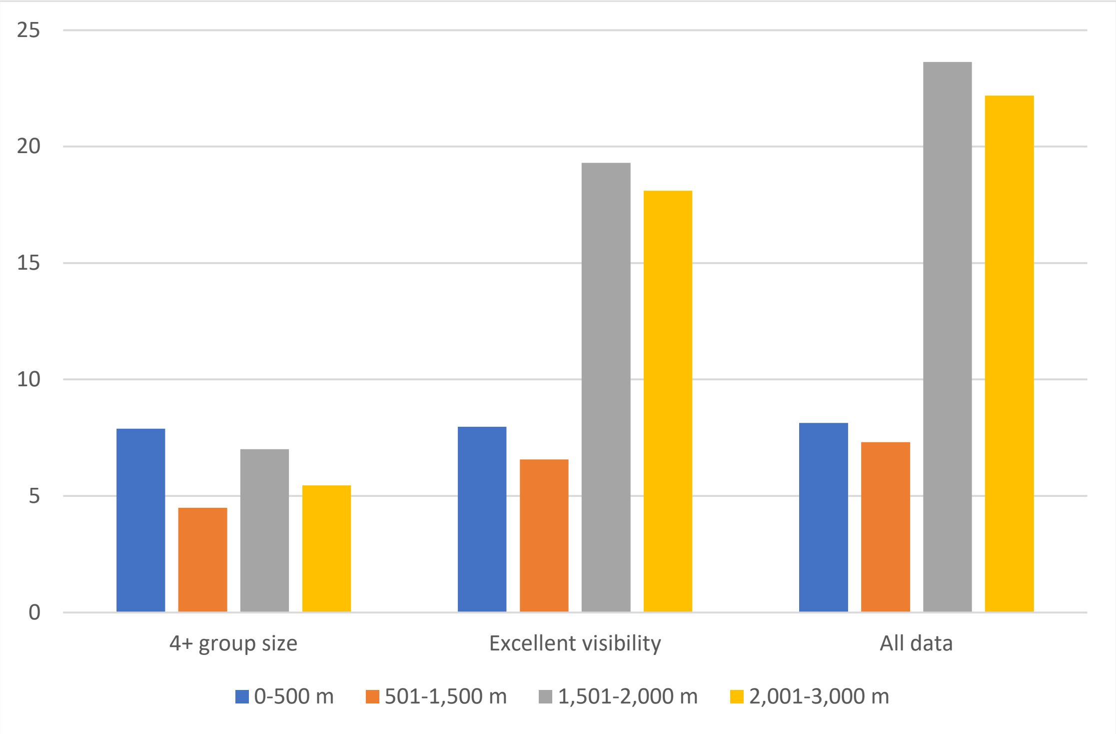


Figure 5-45: Expected density (blue whales/km^2) for each management zones

5.5.9.3 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 define migratory route however, calls recorded in July may be from whales migrating northward towards the east coast of NSW. Calls detected in late August and September may be indication of the presence of whales on their migration route back to Antarctica waters.

The sighting of a cow and calf in the Bonney coast upwelling in April 2000 and the stranding of two fin whale calves in South Australia suggest that this area may be important to the species' reproduction, perhaps as a provisioning area for cows with calves (Morrice et al., 2004). However, there are no defined mating or calving areas in Australia waters.

As there are no BIAs for the fin whale in the activity area or spill EMBA, they are likely to be uncommon visitors to the activity area and spill EMBA. No fin whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

5.5.9.4 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 activity 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.

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

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

5.5.9.7 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 (Kasamatru, 1998; Reilly et al., 2008). Although the exact location of breeding grounds is unknown, mating occurs between August to September with calving between May and July (Bannister et al., 1996). A few animals have been sighted during aerial surveys of the Bonney coast upwelling. The minke whale has been observed within the region however there are no BIAs in the activity area or spill EMBA. Therefore, it is likely that they would be uncommon visitors in the activity 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.

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

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

5.5.9.10 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 5-46). The activity area overlaps the known core coastal range BIA. The activity area is ~67 km from the aggregation BIA and ~90 km from the connecting habitat BIA (Figure 5-46).

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 5-47) (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 5-21, 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. 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.

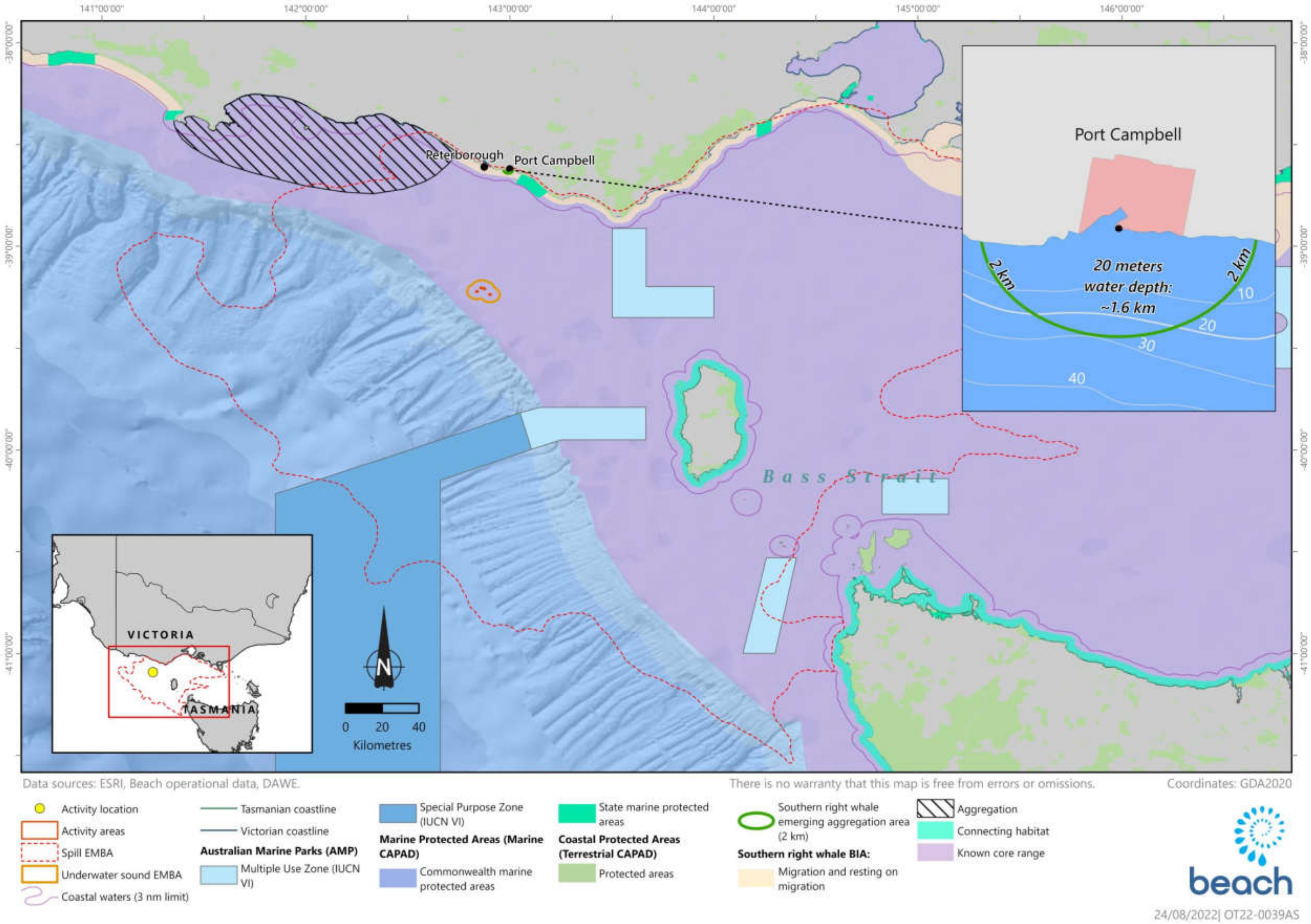


Figure 5-46: Southern right whale BIAs within the spill EMBA

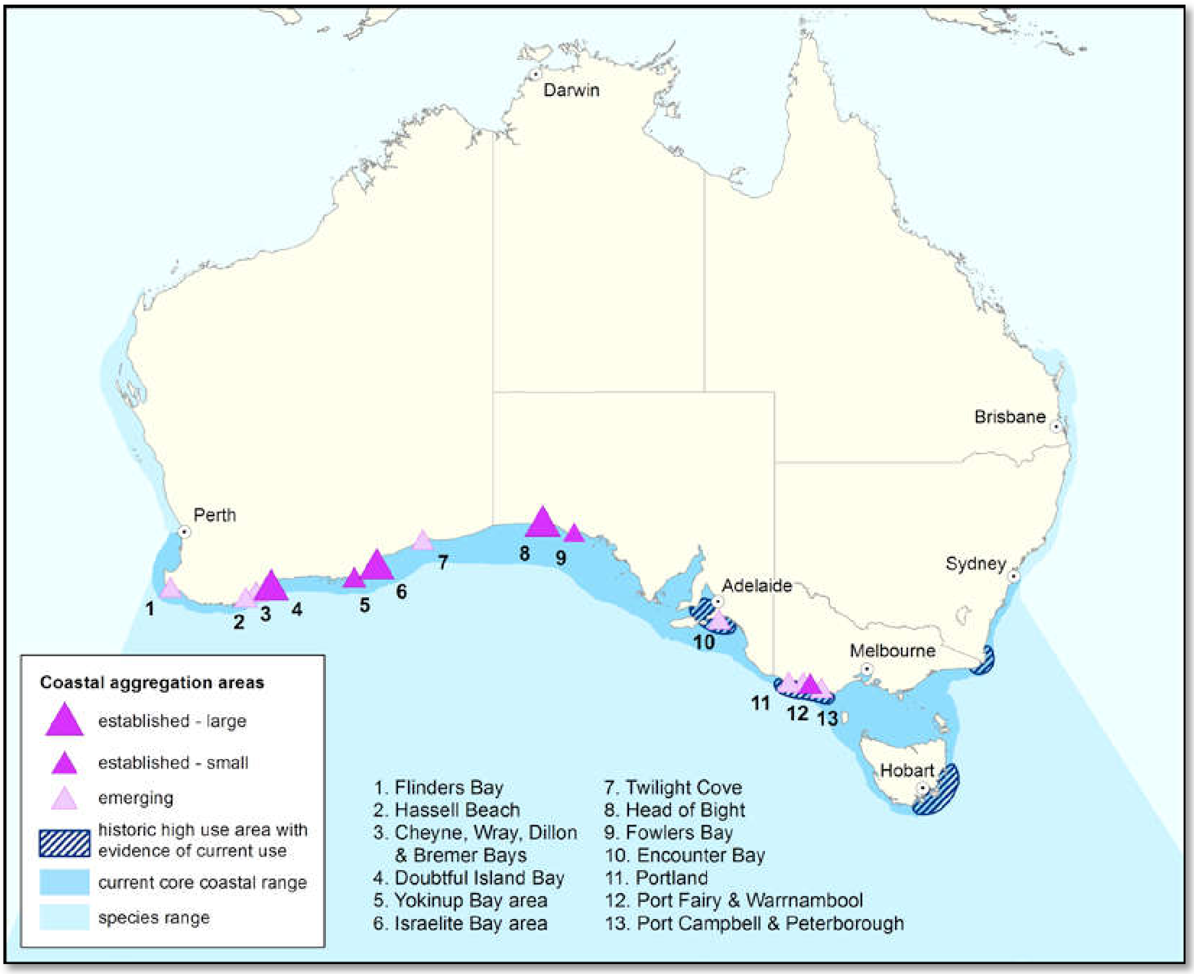


Figure 5-47: Aggregation areas for southern right whales (DSEWPaC, 2012a)

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

5.5.9.12 Dolphins

Bottlenose dolphin

The bottlenose dolphin (*Tursiops truncates*) has a worldwide distribution from tropical to temperate waters. While the species is primarily coastal, they are also found inshore, on the shelf and open oceans.

They are associated with many types of substrate and habitats, including mud, sand, seagrasses, mangroves and reefs (DotEE, 2019j). Bottlenose dolphins are known to associate with several cetacean species such as pilot whales, white-sided, spotted, rough-toothed and Risso's dolphins, and humpback and right whales (DotEE, 2019j).

There are two forms of bottlenose dolphin, a nearshore form and an offshore form. The nearshore form occurs in Southern Australia including the Otway Basin area, while the offshore form is found north of Perth and Port Macquarie in NSW. Most populations are relatively discrete and reside in particular areas, such as individual resident populations in Port Phillip Bay, Westernport Bay, Spencer Gulf, Jervis Bay and Moreton Bay. There may be some migration and exchange between the populations, but it is likely that most encountered near the Victorian coasts are local residents.

During Beach's Otway drilling campaign in 2021, which 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 activity 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 obscures*) is rare in Australian waters and has been primarily reported across southern Australia from Western Australia to Tasmania with a handful of confirmed sightings near Kangaroo Island and off Tasmania (DotEE, 2019i). Only 13 reports of the dusky dolphin have been made in Australia since 1828, and key locations are yet to be identified (Bannister et al., 1996). The species is primarily found from approximately 55°S to 26°S, though sometimes further north associated with cold currents. They are considered to be primarily an inshore species but can also be oceanic when cold currents are present (DotEE, 2019i). No dusky dolphins 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 slop and outer shelf from the tropics to temperate regions. The species prefer warm temperate to tropical waters with depths greater than 1,000 m, although they do sometimes extend their range into cooler latitudes in summer (Bannister et al., 1996). They are thought to feed on cephalopods, molluscs and fish. The Risso's dolphin has been observed in the region, however no BIAs have been identified in the activity area or spill EMBA. Therefore, it is likely they would be uncommon visitors in the activity 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 activity area or spill EMBA. No southern right whale dolphins have been detected during Beach's Otway drilling campaign, which includes the activity location.

5.5.10 Pinnipeds

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

Table 5-25: Listed pinniped species identified in the PMST search

Common name	Species name	EPBC Act listing status			Spill EMBA	Activity area (1 km)
		Threatened	Migratory	Marine		
New Zealand fur-seal	*Arctocephalus forsteri*	-	-	L	SHM	SHM

Common name	Species name	EPBC Act listing status			Spill EMBA	Activity area (1 km)
		Threatened	Migratory	Marine		
Australian fur-seal	*Arctocephalus pusillus*	-	-	L	BK	SHM
Australian sea lion	*Neophoca cinereal*	E	-	L	SHK	
Listed Threatened E: Endangered Listed Marine L: Listed		Likely Presence SHM: Species or species habitat may occur within area. SHK: Species or species habitat known to occur within area. BK: Breeding known to occur within area				

Australian 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 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). An approved Conservation Advice and Recovery Plan apply:

- Conservation Advice *Neophoca cinerea* Australian Sea Lion (TSSC 2020).
- Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC 2013).

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 5-48 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).

Australian fur-seal

Australian fur-seals (*A. pusillus*) breed on islands of the Bass Strait but range throughout waters off the coasts of South Australia, Tasmania, Victoria and NSW. Numbers of this species are believed to be increasing as the population recovers from historic hunting (Hofmeyr et al., 2008). The species is endemic to south-eastern Australian waters.

In Victorian State waters they breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland (Figure 5-49). 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 activity 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.

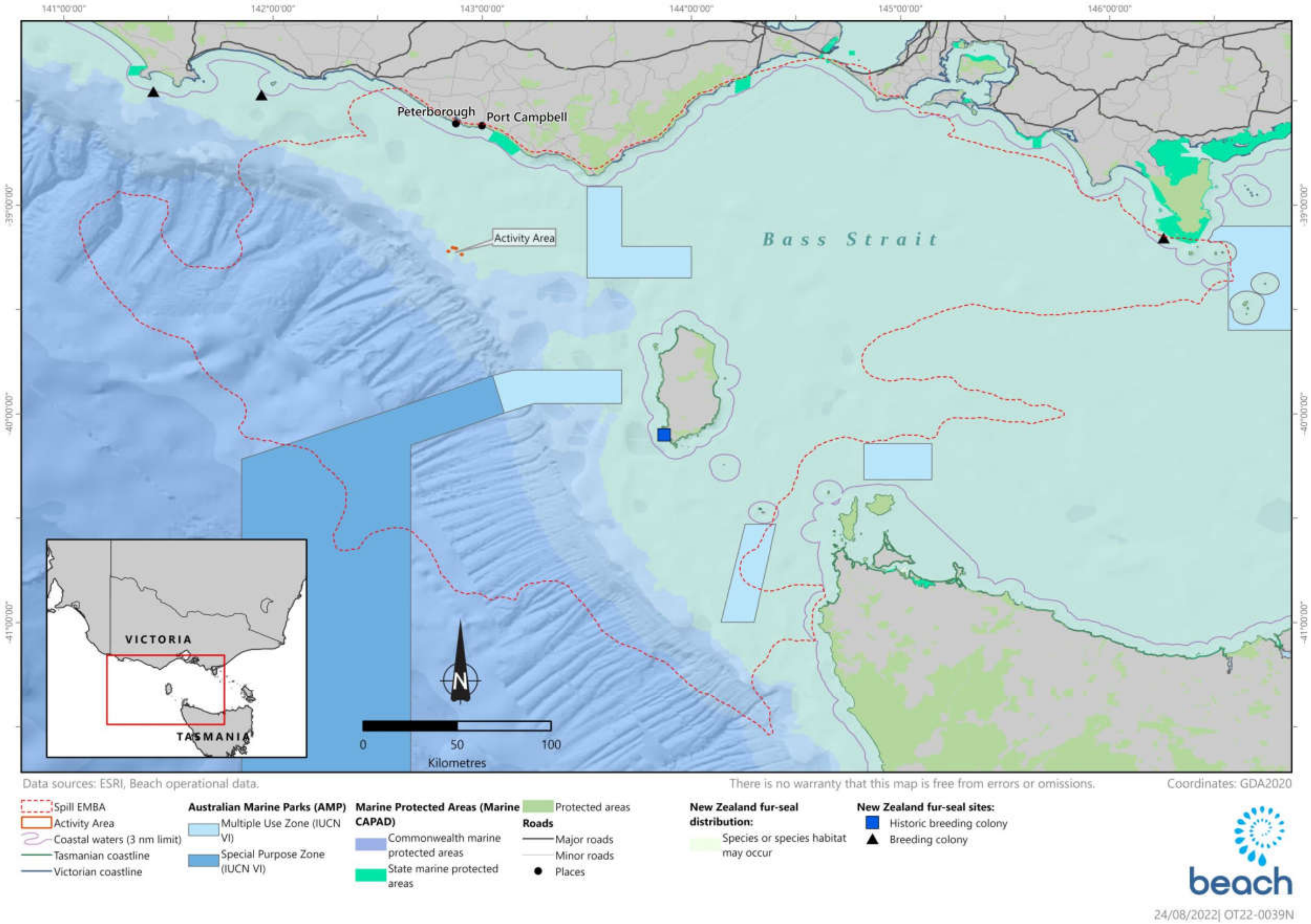


Figure 5-48: Locations of New Zealand fur-seal breeding colonies (Kirkwood et al., 2009)

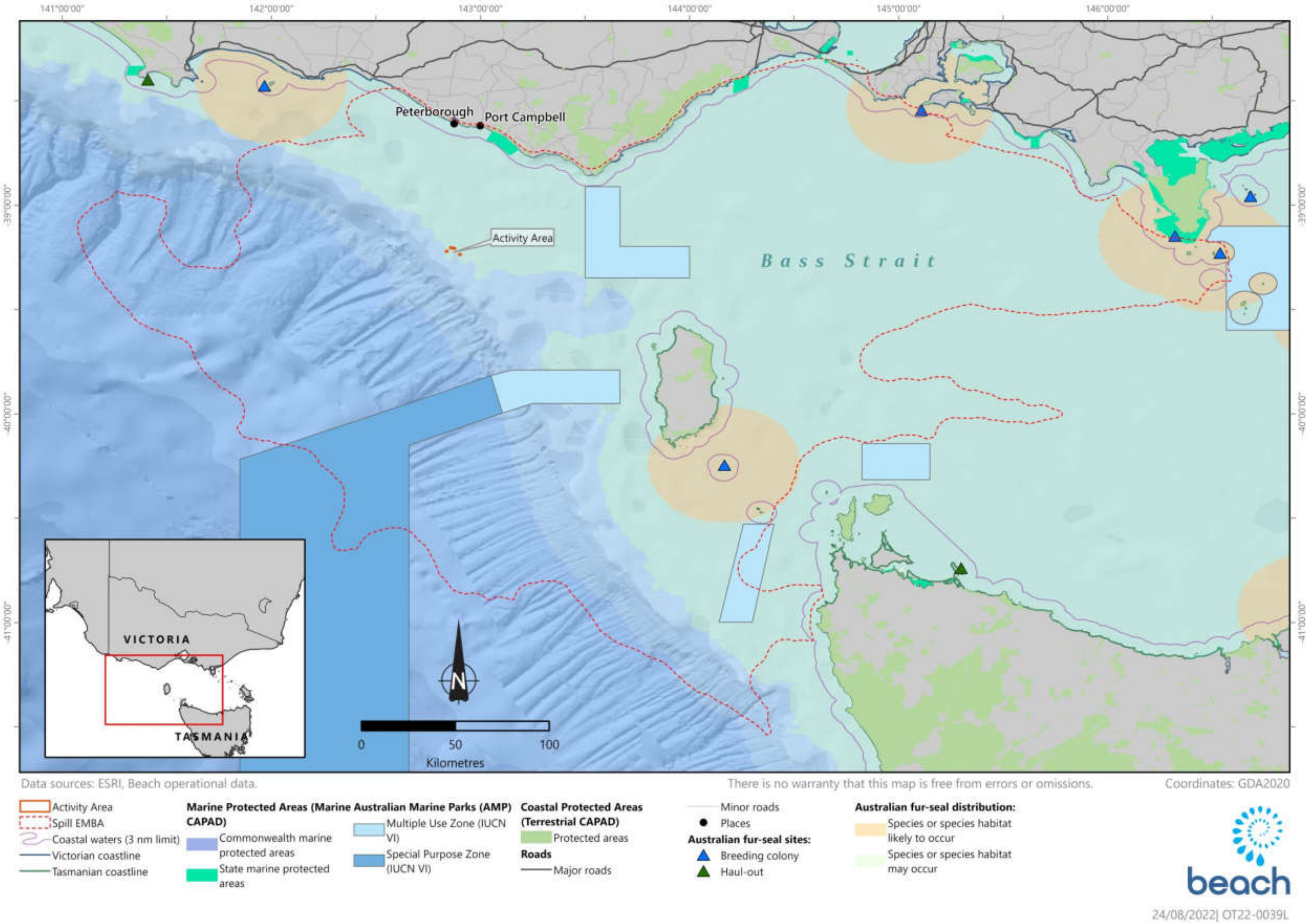


Figure 5-49: Locations of Australian fur-seal breeding colonies and haul out sites (Kirkwood et al., 2010)

5.5.11 Pest species

It is widely recognised that marine pests can become invasive and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati and Grosholz, 2007).

In the South-east Marine Region, 115 invasive marine species (IMS) 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.

The IMS known to occur in Bass Strait, according to Parks Victoria (2020):

- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m (but up to 200 m water depths). It is thought to have been introduced in 1995 through ballast water from Japan. In the VFA's recent scallop abundance survey (see Section 5.4.1), it is noted that no northern pacific seastars were observed.
- New Zealand screw shell (*Maoricolpus roseus*) – lies on or partially buried in sand, mud or gravel in waters up to 130 m deep. It can densely blanket the sea floor with live and dead shells and compete with native scallops and other shellfish for food. This species is known to be present in the Port Phillip and the Western Port region.
- European shore crab (*Carcinus maenas*) – prefers intertidal areas, bays, estuaries, mudflats and subtidal seagrass beds, but occurs in waters up to 60 m deep. It is widespread across Victorian intertidal reef and common in Western Port.
- Dead man's fingers (*Codium fragile ssp. fragile*) – Widespread in Port Phillip and known to inhabit San Remo and Newhaven in Westernport. It grows rapidly to shade out native vegetation and can regenerate from a broken fragment enabling easy transfer from one area to another. Attaches to subtidal rocky reef and other hard surfaces.
- Cord grass (*Spartina anglica* and *Spartina x townsendii sp*) – found at the mouth of Bass River and in drain outlets near Tooradin in Westernport. Widespread in South Gippsland including Anderson's Inlet and Corner Inlet. Invades native saltmarsh, mangroves and mudflats, altering the mud habitat and excluding other species.

The Marine Pests Interactive Map (DAWE, 2019) indicates that Portland (a potential port for mobilisation) harbours the following marine pests:

- Asian date mussel (*Musculista senhousia*) – prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna.
- European fan worm (*Sabella spallanzanii*) - found at depths down to 30 m and is found in nutrient-rich waters in sheltered locations where there are no strong currents and little wave action. It is a filter feeder and grows on soft sediments or anchors itself to rocks, mollusc shells, jetties, pontoons or other solid surfaces.

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

5.5.12 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.

5.6 Socio-economic environment

5.6.1 Coastal settlements

No coastal settlements are predicted to be exposed to shoreline loading from an MDO spill. The nearest settlements to the activity area are Princetown (49 km to the northeast) and Port Campbell (54 km to the north). The Victorian coastal settlements that lie within the spill EMBA and are subject to potential impact are (from west to east) Peterborough, Port Campbell, Princetown, Marengo, Apollo Bay, Skenes Creek, Kennet River, Wye River, Lorne, Moggs Creek, Fairhaven, Aireys Inlet, Anglesea and settlements on the Mornington Peninsula (Portsea, Sorrento, Blairgowrie, Rye, St. Andrews Beach and Cape Schanck). The Tasmanian coastal settlements that lie within the spill EMBA are all located on King Island and include Currie, Cape Wickham, Narracoopa and Grassy.

The larger coastal settlements within the EMBA are described below based on ABS data from the 2021 and 2016 census:

- Port Campbell has a population of 440 and a median age of 40 (ABS, 2021). The 2016 census data reported those in the labour force, 55.6% work full-time and 32.2% work part-time. The accommodation and dairy farming industries employ 33.9% of the workforce and the managers, labourers and professionals make up 63.3% of occupations (ABS, 2016).

- Apollo Bay has a population of 1,790 people and a median age of 52 (ABS, 2021. The 2016 census data reported those in the labour force, 43% work full-time and 45.7% work part time. Labourers and mangers are the highest occupation making up 37.4% of the workforce. Accommodation and cafes and restaurants are the biggest industries, making up 22.9% of employment (ABS, 2016)

- Anglesea has a population of 3,208 and a median age of 54 (ABS, 2021). The 2016 census data reported those in the labour force, 51.4% work full-time and 39.3% work part-time. The most common occupations are professionals and technicians and trade workers, making up 42.5% of the workforce. Accommodation and supermarket and grocery stores are the biggest industries at 8.8% of employment (ABS, 2016).

- Mornington Peninsula has a population of 168,948 people and a median age of 48 (ABS, 2021). Based on the 2016 census data for the shire region the Mornington Peninsula Of those in the labour force, 53.5% work full-time with 36.3% working part-time. The agriculture, forestry and fishing industries employ 0% of the work. Hospitals, primary education and supermarket and grocery stores employ 9.4% of the workforce. Professionals, technicians and trade workers and managers make up 50.6% of occupations (ABS, 2016).

- Cape Schanck – Cape Schanck has a population of 569 and a median age of 55 (ABS, 2021). Based on the 2016 census data 49.1% of the workforce work full time and 39.6% work part-time. The most common occupations are professionals and technicians and trade workers making up 41.4% of the workforce. Real estate services and landscape construction services are the biggest industries at 10.3% of employment (ABS 2016).

5.6.2 Offshore petroleum exploration and production

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 (now DJPR) reported 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. In 2018, Victoria accounted for 11% of Australia's crude oil production, 11% of Australia's condensate production, 49% of Australia's LPG production and 10% of Australia's conventional gas production (APPEA, 2019). Production has been trending down since it peaked in 2000.

There is no non-Beach oil and gas infrastructure within the activity area.

5.6.3 Other infrastructure

The Victorian Desalination Plant, located at Wonthaggi, is located 237 km northeast of the activity area and is outside of the EMBA. Operation of the plant commenced in December 2012. The seawater intake and outlet structures are connected to the onshore plant via a 1.2 km and 1.5 km underground tunnel, respectively. The two intake structures are 8 m high, 13 m in diameter, situated 50 m apart and located in a water depth of 20 m. They draw in water at very low speeds (the suction effect is not strong enough to draw fish in).

There are two Telstra telecommunications cables located in central Bass Strait (Figure 5.46), with the closest one located 228 km east of the activity area.

The Indigo Central telecommunications cable, which connects Perth and Sydney through southern Australia, is located 19 km south of the activity area.

5.6.4 Shipping

The South-east Marine Region (which includes Bass Strait) is one of the busiest shipping regions in Australia (Commonwealth of Australia, 2015). Shipping consists of international and coastal cargo trade, passenger services and cargo and vehicular ferry services across Bass Strait (Commonwealth of Australia, 2015).

The *Spirit of Tasmania* ferry service runs between Melbourne and Devonport (northern Tasmania) on a daily basis. The crossing is 429 km long and during non-peak times (May to August) the ferry departs each port in the evening and during peak times (September to April) day sailings are offered as well. The voyage ferry takes 11 hours on days of single sailings and 9 hours on days of double sailings. The ferry routes are located about 157 km east of the activity area but are intersected by the spill EMBA (Figure 5-50).

Vessel traffic recorded by AMSA for the activity area for the whole of 2020 was analysed to determine the presence of commercial shipping. Vessel traffic was only recorded by AMSA during February and March, with each month recording the presence of one cargo ship each. Given the small size of the activity area and that it is located within an existing Petroleum Safety Zone (PSZ), this may influence the low levels of shipping traffic recorded.

A 20 km buffer was applied around the activity area to determine the extent of vessel activity in the waters adjacent to the activity area. A summary of the data recorded by AMSA for this area during 2020 is presented in Table 5-26. This analysis indicates that a total of 1,333 ships passed through this area during 2020. The majority of these (989 ships, or 74%) are cargo ships, with tankers being the next most frequent (289 ships, or 22%). On average, 111 vessels pass through or idle within a 20 km radius of the activity area each month.

Table 5-26: Summary of shipping traffic within and adjacent to the activity area (2020 calendar year)

Vessel type	Number of vessels	Average length (m)	Average speed (km/h)
Cargo ship	989	201	22
Tanker	289	193	20
Passenger ship	24	205	23
Other	23	115	19
Tug / tow	4	87	5.5
Fishing	2	22	14
Engaged in diving operation	1	117	20
Total	1,333	-	-

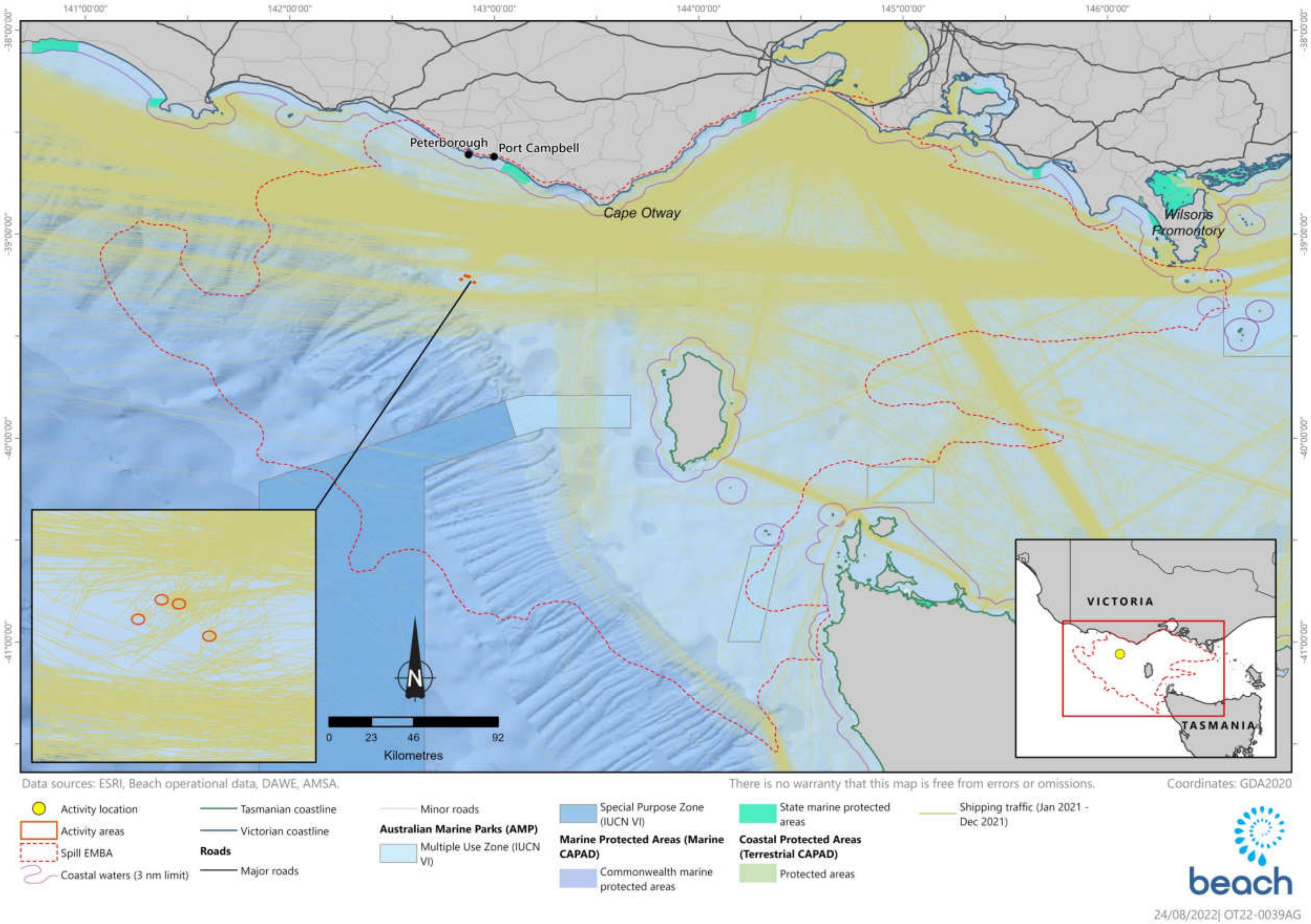


Figure 5-50: Vessel traffic within the spill EMBA and activity area

5.6.5 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.

5.6.6 Recreation

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.

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 spill 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.

5.6.7 Commercial Fisheries

5.6.7.1 Commonwealth managed fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) under the *Fisheries Management Act 1991* (Cth). AFMA jurisdiction covers the area of ocean from 3 nm from the coast out to the 200 nm limit (the Australian Fishing Zone (AFZ)). Commonwealth commercial fisheries with jurisdictions to fish within the EMBA are the:

- Southern and Eastern Scalefish and Shark (SESS) Fishery, incorporating:
  - Gillnet and Shark Hook sector;
  - Commonwealth Trawl sector; and
  - Scalefish Hook sector.
- Southern Squid Jig Fishery;
- Bass Strait Central Zone Scallop Fishery;
- Eastern Tuna and Billfish Fishery;
- Eastern Skipjack Tuna Fishery;
- Southern Bluefin Tuna Fishery; and
- Small Pelagic Fishery.

Table 5-27 summarises the key information for each of these fisheries and indicates that the Bass Strait Central Zone Scallop Fishery, the Small Pelagic Fishery, the Southern Squid Jig Fishery and the shark gillnet sector of the SESS Fishery are actively fishing in the spill EMBA. Detailed mapping is provided where there is overlap between recent fishing intensity and the spill EMBA.

Table 5-27: Commonwealth managed fisheries within the spill EMBA

Fishery	Target species	Geographic extent of fishery	Fishing in spill EMBA or activity area?	Fishing season	Fishing methods, vessels and licences	Catch data and other information	
						whole of fishery	activity area-specific
SESSF Shark Gillnet (Figure 5-51) and Shark Hook (Figure 5-52) Sector	Gummy shark (*Mustelus antarcticus*) is the key target species, with bycatch of elephant fish (*Callorhinchus milii*), sawshark (*Pristiophorus cirratus, P. nudipinnis*), and school shark (*Galeorhinus galeus*).	Waters from the NSW/Victorian border westward to the SA/WA border, including the waters around Tasmania, from the low water mark to the extent of the AFZ. Most fishing occurs in waters adjacent to the coastline in Bass Strait. Primary landing ports include Adelaide, Port Lincoln, Robe, Devonport, Hobart, Lakes Entrance, San Remo and Port Welshpool.	**Activity area?** **Yes.** **Spill EMBA?** **Yes.** Based on 2020-21 fishing intensity data, the spill EMBA overlaps areas of low, medium and high intensity fishing.	12-month season begins 1st May. Fishery catch is distributed across the year, with no defined peak periods of catch.	Demersal gillnet and a variety of line methods. Landing ports in Victoria are Lakes Entrance, San Remo and Port Welshpool. 2020-21 – 34 permits and 69 vessels 2019-20 – 74 permits and 72 vessels. 2018-19 – 74 permits and 78 vessels. 2017-18 – 74 permits and 76 vessels. 2016-17 – 74 permits and 62 vessels.	In 2015-16, the SESS Fishery was the largest Commonwealth fishery in terms of volume produced. • 2020-2021 – 2,268 tonnes no value statistic available. • 2019-20 – 2,201 tonnes worth $19.67 million. • 2018-19 – 2,126 tonnes worth $23.66 million. • 2017-18 – 2,216 tonnes worth $19.1 million. • 2016-17 – 2,118 tonnes worth $18.3 million. • 2015-16 – 2,233 tonnes worth $18.4 million.	Mapped 2020-2021 fishing intensity for the Shark Gillnet sector shows the activity area overlaps part of the total area of waters fished. The Shark Hook sector 2020-2021 mapped fishing intensity shows the activity area overlaps part of the total area of waters fished.
SESSF Commonwealth Trawl Sector (CTS) – otter board (Figure 5-53) and Danish seine (Figure 5-54)	Key species targeted are eastern school whiting (*Sillago flindersi*), flathead (*Platycephalus richardsoni*) and gummy shark (*Mustelus antarcticus*).	Covers the area of the AFZ extending southward from Barrenjoey Point (north of Sydney) around the New South Wales, Victorian and Tasmanian coastlines to Cape Jervis in South Australia.	**Activity area?** **Yes.** **Spill EMBA?** **Yes.** Based on 2019-20, fishing intensity data, the spill EMBA overlaps areas of low, medium, and high fishing intensity.	12-month season begins 1st May. Highest catches from September to April.	Multi gear fishery, predominantly demersal otter trawl and Danish-seine methods. Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria. For 2020-2021, there were 57 trawl fishing rights with 54 active trawl and Danish-seine vessels.	Recent catch data • 2020-2021 – 18,985 tonnes with no value available. • 2019-20 –13,072 tonnes worth $51.34 million • 2018-19 – 8,454 tonnes worth $49.47 million. • 2017-18 – 8,631 tonnes worth $41.86 million. • 2016-17 – 8,691 tonnes, worth $46.42 million. • 2015-16 – 9,025 tonnes, worth $41.5 million.	Mapped 2020-2021 fishing intensity shows the activity area overlaps part of the total area of waters fished within both otter-board and Danish-seine waters sectors.
SESSF Scalefish Hook Sector (SHS) (Figure 5-55)	Key species targeted are gummy shark (*Mustelus antarcticus*), elephantfish (*Callorhinchus milii*) and draughtboard shark (*Cephaloscyllium laticeps*).	Includes all waters off South Australia, Victoria and Tasmania from 3 nm to the extent of the AFZ.	**Activity Area?** **Yes.** **Spill EMBA?** **Yes.** Based on 2020-21 fishing intensity data, the spill EMBA overlaps part of the total area of waters fished.	12-month season begins 1st May. Effort highest from January to July.	Multi gear fishery, using different gear types in different areas or depth ranges. Predominantly demersal longline fishing methods, some of which are automated, and demersal gillnets. For 2019-20, there were 37 fishing rights 24 active vessels. Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria.	Logbook catches have been gradually declining since 2006 and are now <2,000 t/year. Catch data is combined with that for the CTS.	Mapped 2020-2021 fishing intensity for the scalefish hook sector shows the activity area overlaps part of the total area of waters fished
Southern Squid Jig Fishery (Figure 5-56)	Arrow squid (*Nototodarus gouldi*)	The fishery extends from the SA/WA border east to southern Queensland. AFMA does not control squid fishing in Victorian or Tasmanian state waters. Primary landing ports of the fishery are Triabunna, Portland, Port Fairy, and Queenscliff.	**Activity area?** **Yes.** **Spill EMBA?** **Yes.**	12-month season begins 1st January and ends 31 December.	Squid jigging is the fishing method used, mainly at night time and in water depths of 60 to 120 m. High-powered lamps are used to attract squid. In 2020 there were 5 active vessels.	The species' short life span, fast growth and sensitivity to environmental conditions result in strongly fluctuating stock sizes. • 2020 – 480 tonnes worth $2.14 million. • 2019 – 722 tonnes worth $2.89 million. • 2018 – 1,649 tonnes worth $5.26 million. • 2017 – 828 tonnes worth $2.24 million. • 2016 – 981 tonnes worth $2.57 million. • 2015 – 824 tonnes worth $2.33 million.	Fishing catch and effort was reported from the activity area in 2019. Mapped 2020 fishing intensity for the SSJF shows the activity overlaps part of the total area of waters fished
Bass Strait Central Zone Scallop Fishery (Figure 5-57)	Commercial scallop (*Pecten fumatus*)	Central Bass Strait area that lies within 20 nm of the Victorian and Tasmanian coasts. Fishery does not operate in state waters. Fishing effort is concentrated east of King Island. Primary landing ports are Devonport, Stanley, Apollo Bay, Melbourne, Queenscliff and San Remo.	**Activity Area?** **No.** **Spill EMBA?** **Yes.** Spill EMBA overlaps part of the total area of waters fished and intersect the main fishing intensity locations concentrated around King Island and Flinders Island (2020).	July to 31st December.	Towed scallop dredges that target dense aggregations ('beds') of scallops. 43 fishing permits are in place. 9 vessels were active in the fishery in 2020, a decrease from 26 active vessels in 2009, reflecting the 'boom or bust' nature of the fishery.	• 2020 – 2,732 tonnes worth $5.3 million. • 2019 – 2,946 tonnes with $6.3 million. • 2018 – 3,253 tonnes worth $6.7 million. • 2017 – 2,929 tonnes worth $6.7 million. • 2016 – 2,885 tonnes worth $4.6 million. • 2015 – 2,260 tonnes worth $2.8 million. Scallop spawning occurs from winter to spring (June to November), with timing dependent on environmental conditions such as wind and water temperature. Majority of catch occurs during September – December east of King Island.	Mapped 2020 fishing intensity for the BSCZSF shows the activity area is within the fisheries management area, but no fishing had occurred.

Fishery	Target species	Geographic extent of fishery	Fishing in spill EMBA or activity area?	Fishing season	Fishing methods, vessels and licences	Catch data and other information: whole of fishery	Catch data and other information: activity area-specific
Southern Bluefin Tuna	Southern bluefin tuna (*Thunnus maccoyii*)	The fishery extends throughout all waters of the AFZ. AFMA manages Southern Bluefin Tuna stocks in Victorian state waters under agreements set up within the OCS (DEH, 2004). The nearest fishing efforts are concentrated along the NSW south eastern coast and along the SA south eastern coast, both at around the 200 m depth contour. (2020) The primary landing port is Port Lincoln.	**Activity area?** **No.** There is no overlap between the activity area and recent fishing effort **Spill EMBA?** **No.**	12-month season begins 1st December.	Purse seine catch in the Great Australian Bight for transfer to aquaculture farms off Port Lincoln in South Australia (five to eight vessels consistently fish this area). Port Lincoln is the primary landing port. On the east coast, pelagic longline fishing is the key fishing method. 2018-19 – 27 active vessels.	No recent fishing effort in Bass Strait. The latest data for the east coast pelagic longline catches are: • 2019-2020 – 5,429 tonnes worth 41.27 million. • 2018-19 – 6,074 tonnes worth $43.41 million. • 2017-18 – 6,159 tonnes worth $39.73 million. • 2016-17 – 5,334 tonnes worth $38.57 million. • 2015-16 – 5,636 tonnes worth $37.29 million. • 2014-15 – 5,519 tonnes worth $37.29 million.	No fishing catch or effort was reported from the activity area in 2019.
Small Pelagic Fishery (eastern and western sub-area)	Australian sardine (*Sardinops sagax*), jack mackerel (*Trachurus declivis*), blue mackerel (*Scomber australasicus*), redbait (*Emmelichthys nitidus*)	Operates in Commonwealth waters extending from southern Queensland around southern Western Australia. Primary landing ports are Iluka and Ulladulla (NSW).	**Activity area?** **No.** **Spill EMBA?** **No.**	12-month season begins 1st May.	Purse seine and mid-water trawl, with the latter being the main method. Thirty-three (33) entities held licences in 2020-21 using four active vessels.	A Total Allowable Commercial Catch (TACC) in recent years has not been reached. Some catch and effort values are confidential due to the small number of fishers. • 2020-2021- 13,766 tonnes. • 2019-20 – 16,093 tonnes. • 2018-19 – 9,424 tonnes. • 2017-18 – 5,713 tonnes. • 2016-17 – 8,038 tonnes. • 2015-16 – 10,394 tonnes.	No fishing catch or effort was reported from the activity area in 2018.
Eastern Tuna and Billfish Fishery	Albacore tuna (*Thunnus alulunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*), broadbill swordfish (*Xiphias gladius*), striped marlin (*Tetrapturus audux*)	Fishery extends from Cape York in Queensland to the South Australian/Victorian border. Fishing occurs in both the AFZ and adjacent high seas.	**Activity area?** **No.** **Spill EMBA?** **No.**	12-month season begins 1st March. January?	Pelagic longline is the key fishing method, with small quantities taken using minor line methods (such as handline, troll, rod and reel). Active vessel numbers were 37 in 2019 (down from about 150 in 2002). No Victorian or Tasmanian ports are used to land catches.	Catch data and economic value available for the last five years: • 2020 – 3,945 tonnes worth $39.8 million • 2019 – 4,341 tonnes worth $32.1 million. • 2018 – 4,046 tonnes worth $38.4 million. • 2017 – 4,624 tonnes worth $35.7 million. • 2016 – 5,139 tonnes worth $47.1 million. • 2015 – 5,408 tonnes worth $33 million. Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012).	2020 mapped fishing intensity did not show any fishing intensity/effort with the activity area or EMBA.
Eastern Skipjack Tuna Fishery	Skipjack tuna (*Katsuwonus pelamis*)	Extends from the border of Victoria and South Australia to Cape York, Queensland.	**Activity area?** **No.** The fishery is not currently active. **Spill EMBA?** **No.** The fishery is not currently active.	Not currently active.	Purse seine fishing gear is used in this fishery. There are 19 permits in the eastern zone, though no vessels currently work the fishery. Port Lincoln was the main landing port until its tuna cannery closed down in 2010.	Not currently active. The last fishing effort in the fishery occurred in 2008-09.	Not currently active. The last fishing effort in the fishery occurred in 2008-09.

Sources: Patterson et al (2020, 2019, 2018; 2017; 2016), AFMA (2020,) ABARES (2021)

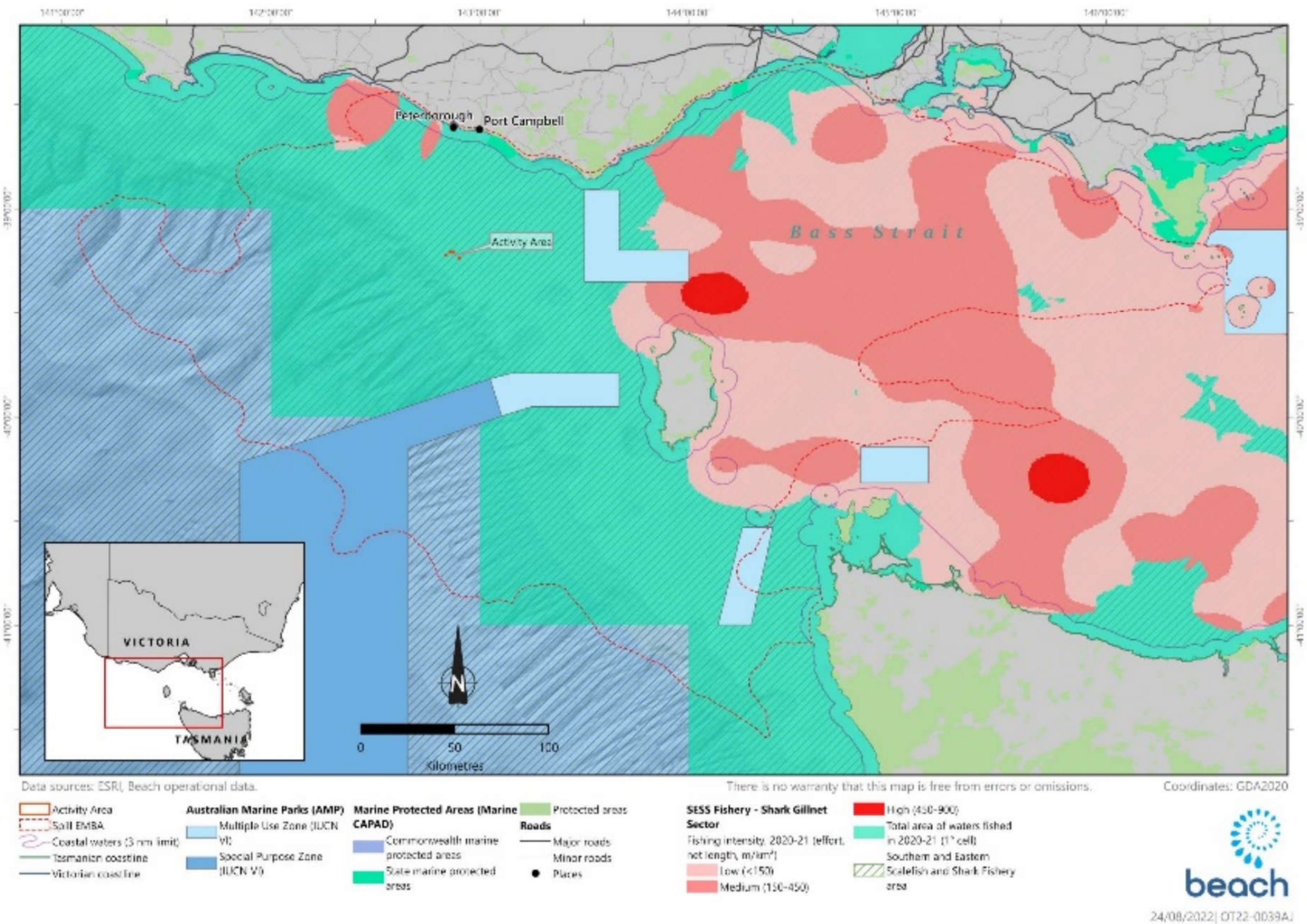


Figure 5-51: SESSF (Shark Gillnet Sector) Fishing Intensity (effort, net length, m/km^2)

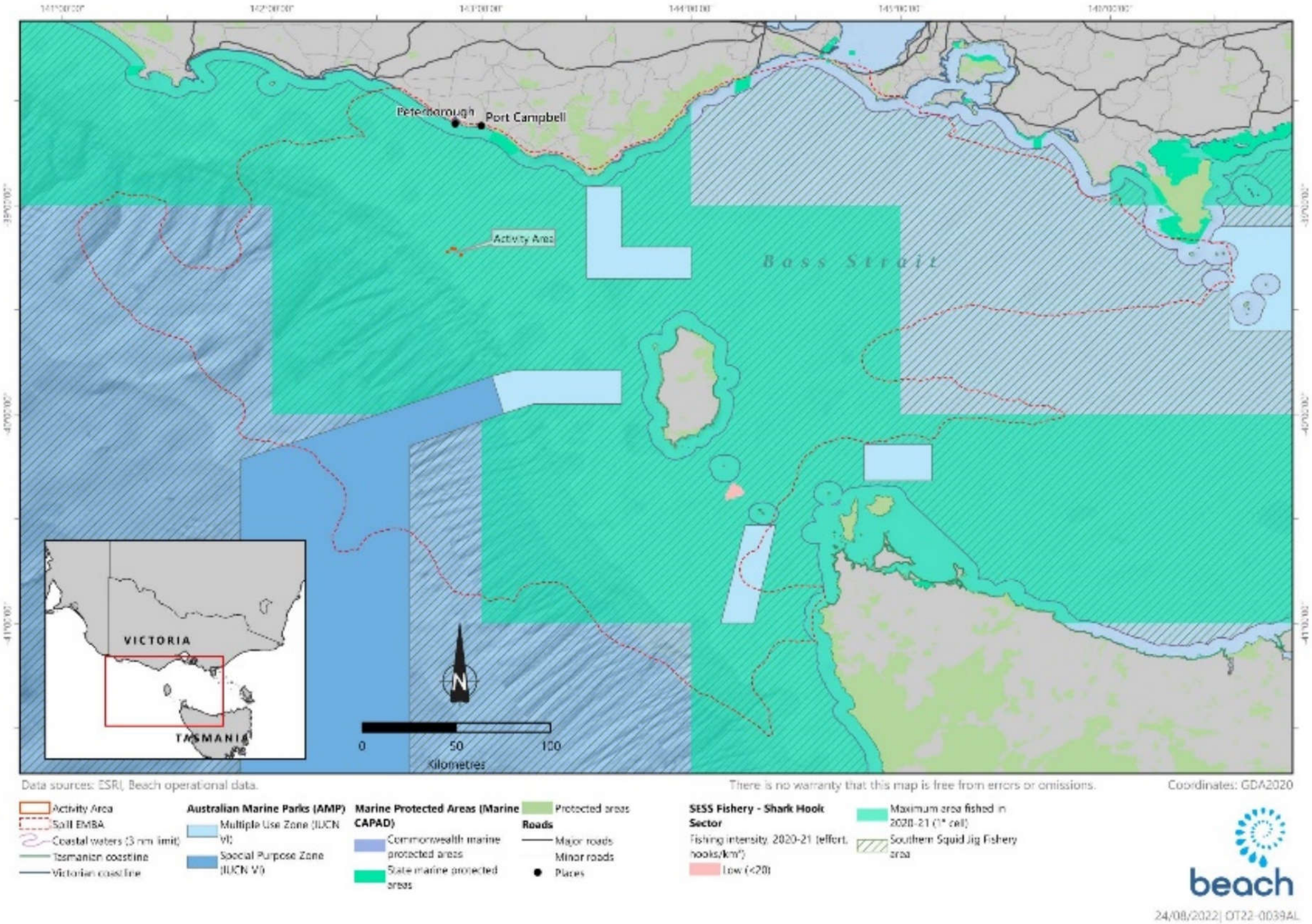


Figure 5-52: SESSF (Shark Hook Sector) Fishing Intensity (effort, net length, m/km^2)

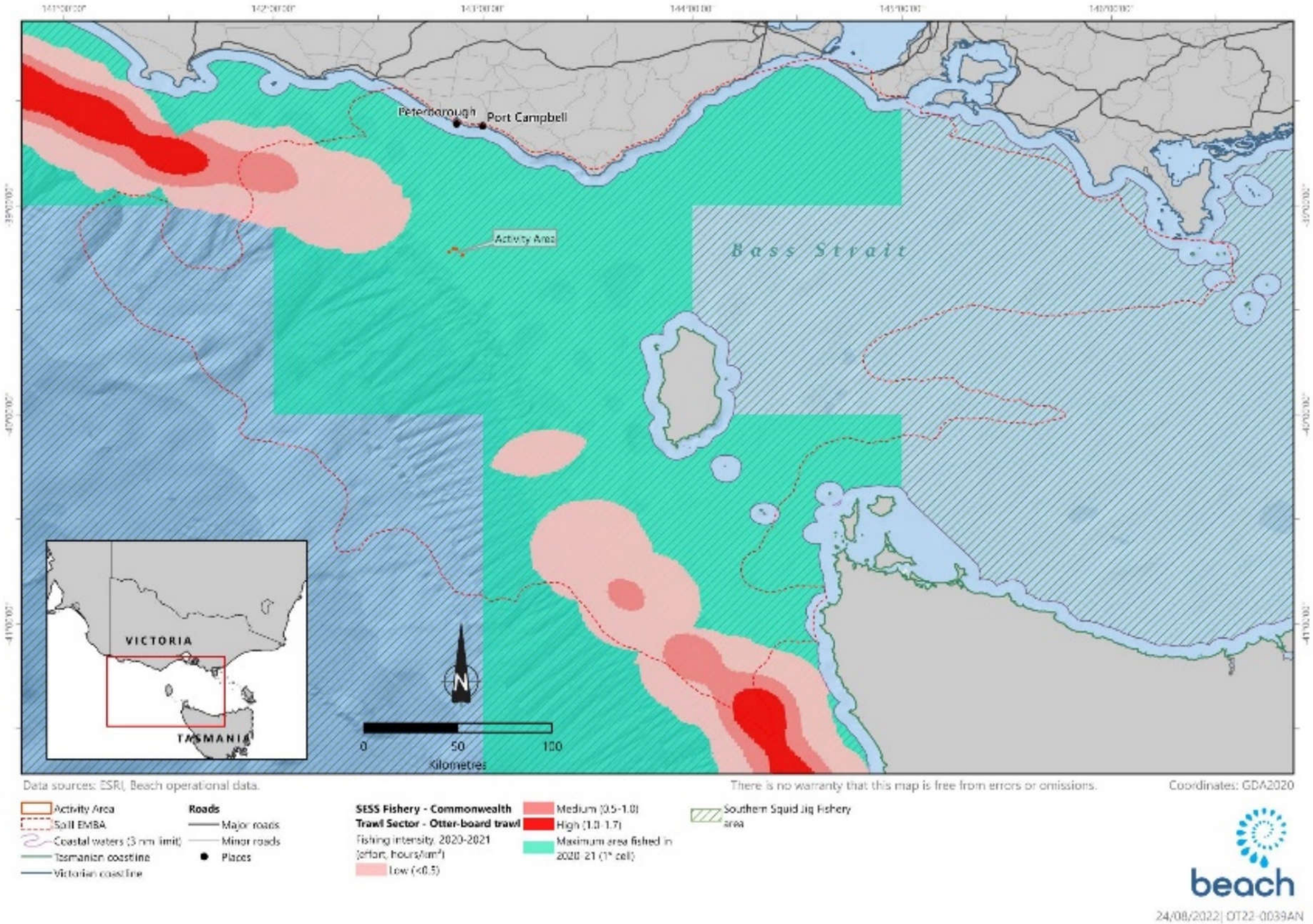


Figure 5-53: SESSF (Commonwealth Trawl Sector – otter board) Fishing Intensity (effort, net length, m/km^2)

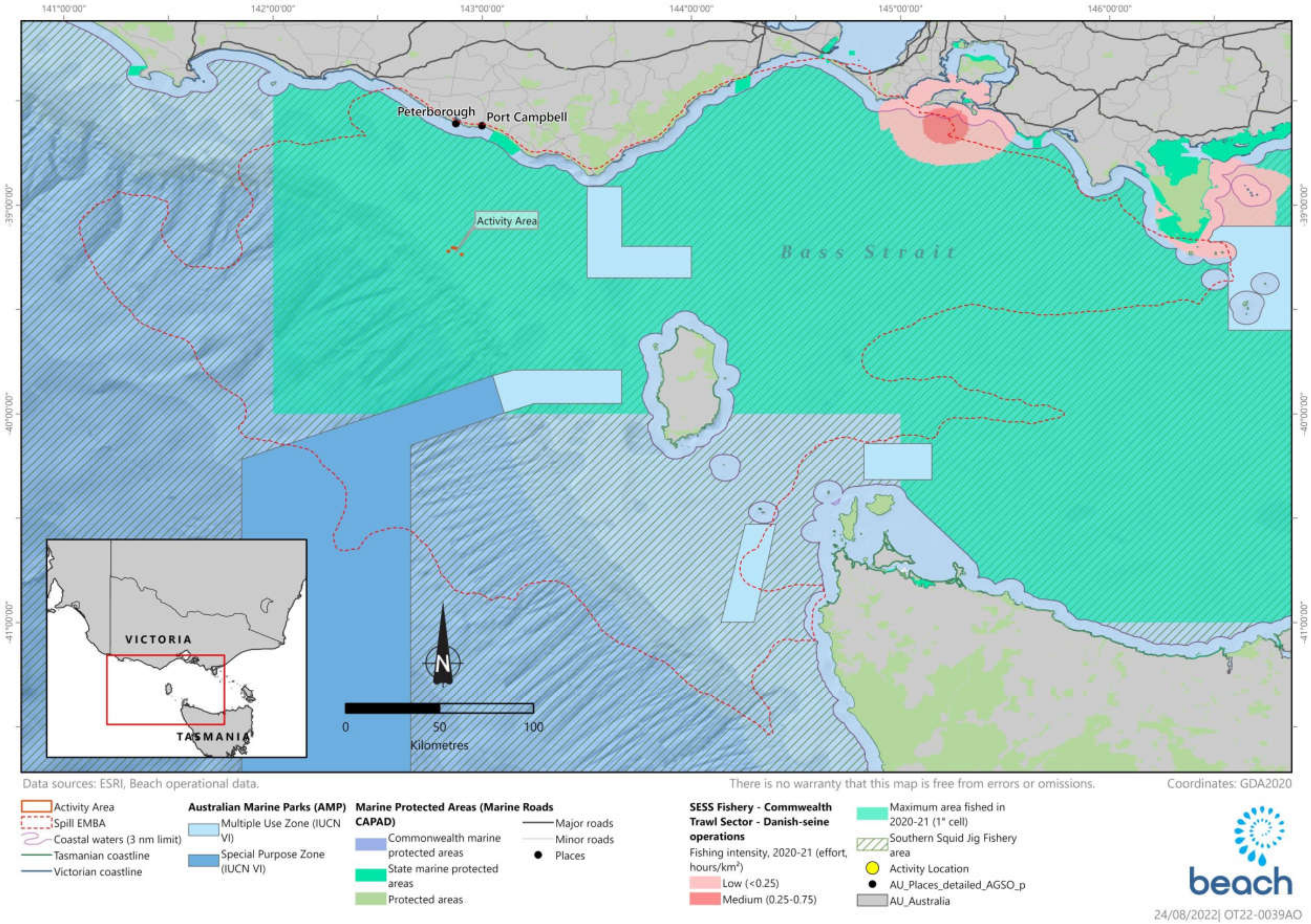


Figure 5-54: SESSF (Commonwealth Trawl Sector – Danish seine) Fishing Intensity (effort, net length, m/km^2)

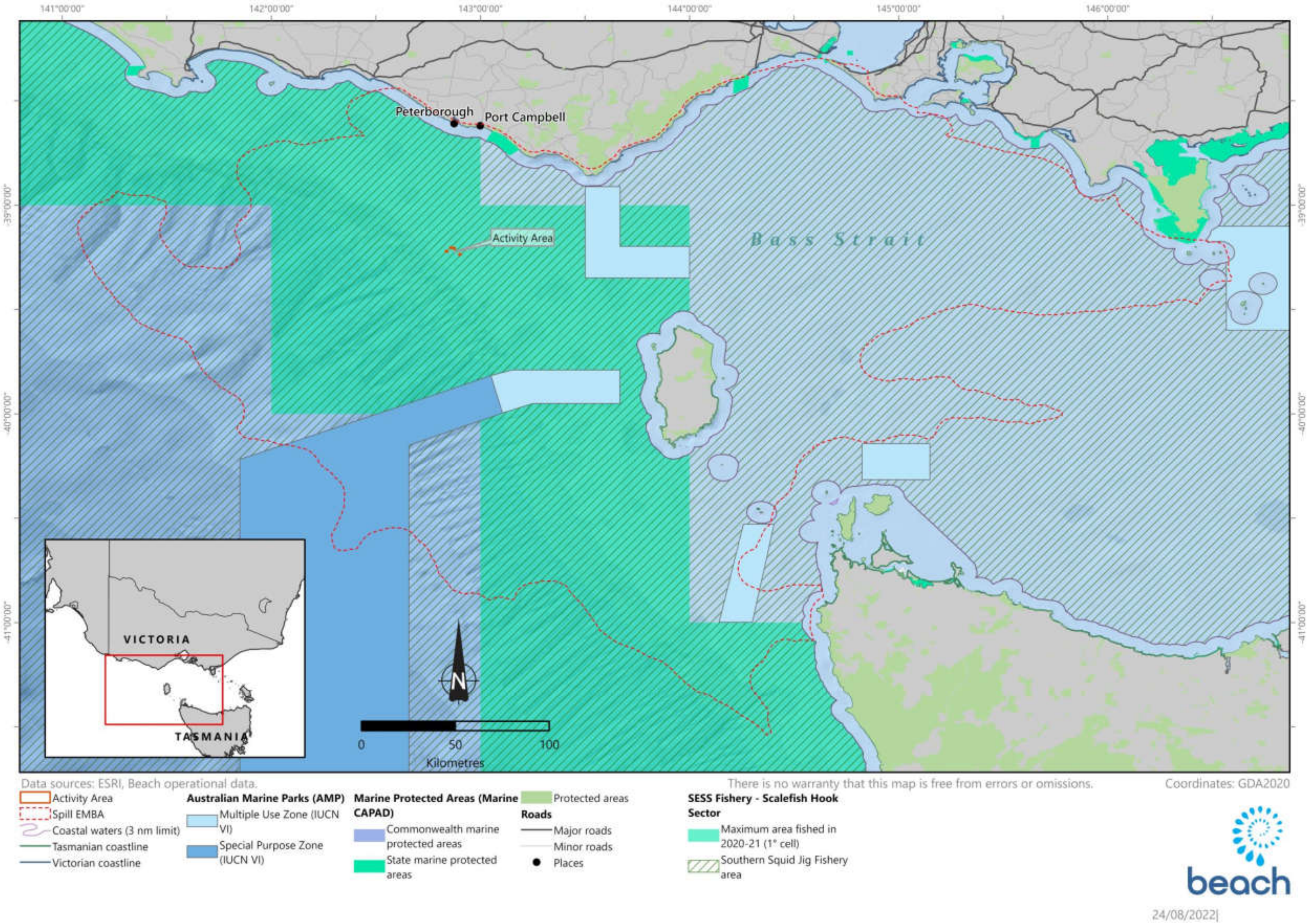


Figure 5-55: SESSF (Scalefish Hook Sector) Fishing Intensity (effort, net length, m/km²)

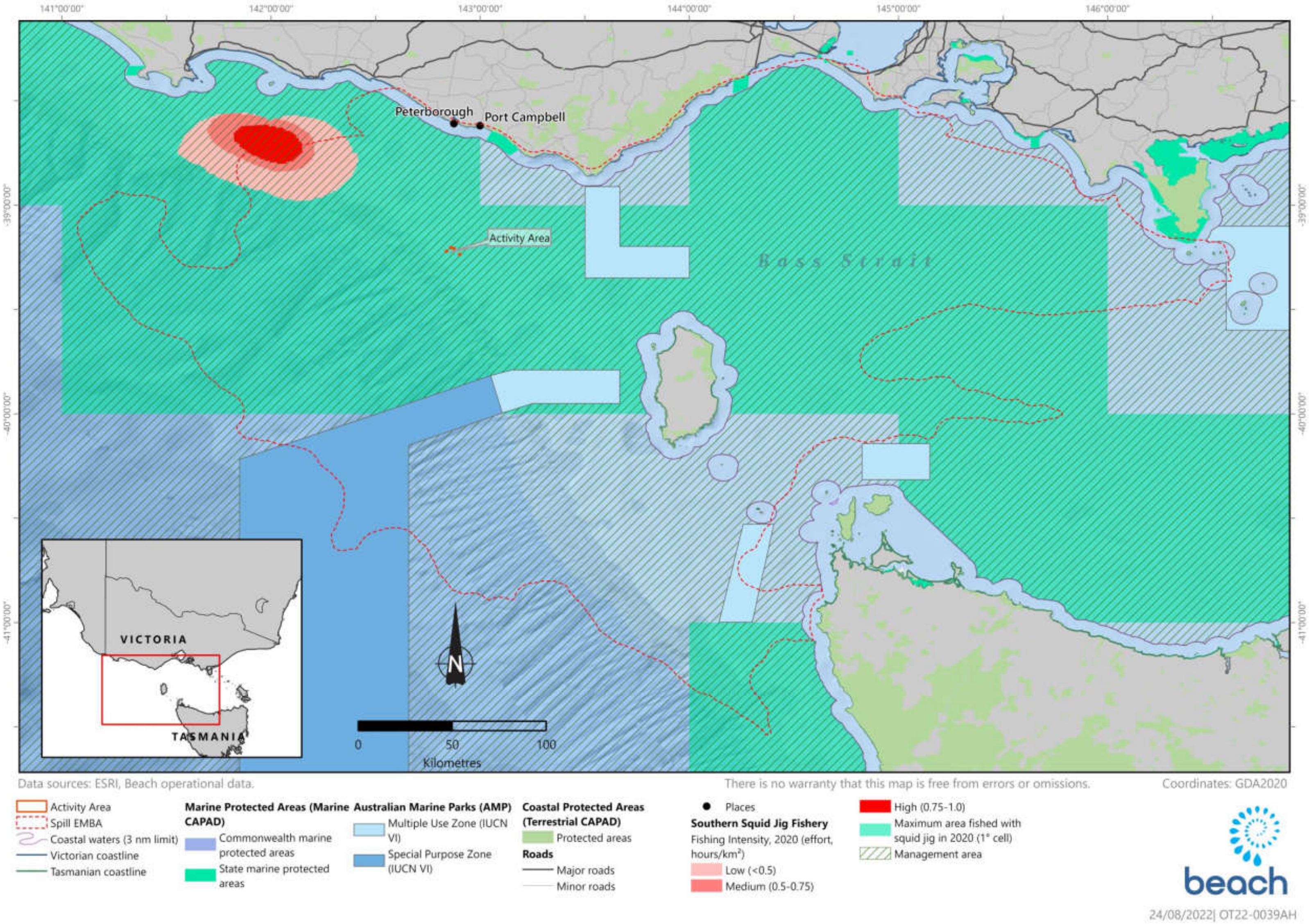


Figure 5-56: Jurisdiction of and fishing intensity of the Southern Squid Jig Fishery

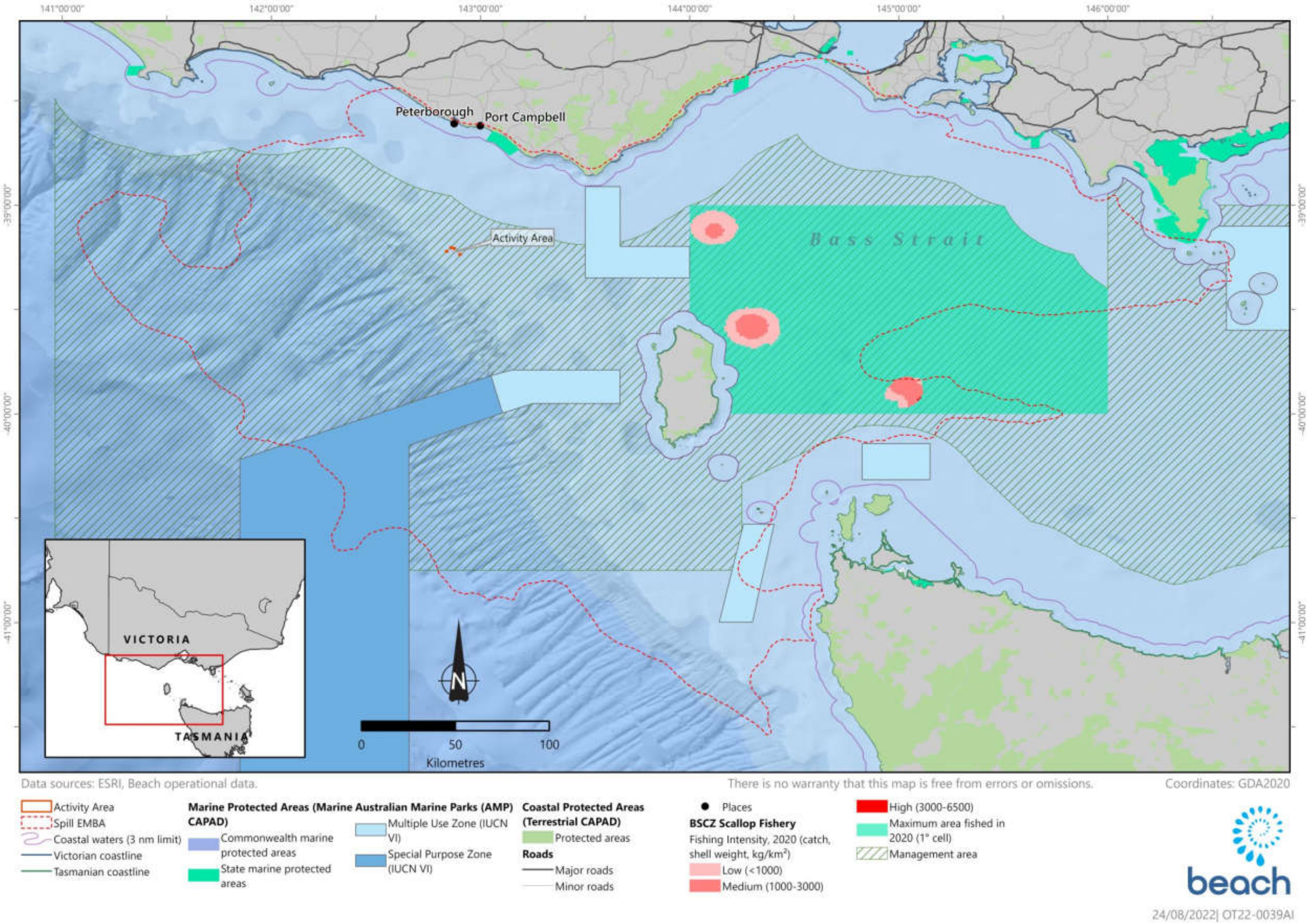


Figure 5-57: Jurisdiction of and fishing intensity of the Bass Strait Central Zone Scallop Fishery

5.6.7.2 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

The Victorian Fisheries Authority (VFA) catch and effort grid cell network is based on divisions of 10′ latitude (approximately 10 nm) and 12.1′ longitude (approximately 12.1 nm) (Figure 5-58). Table 5-28 summarises the key information for each of these fisheries and indicates that all the above-listed fisheries are actively fishing in the activity area and spill EMBA.

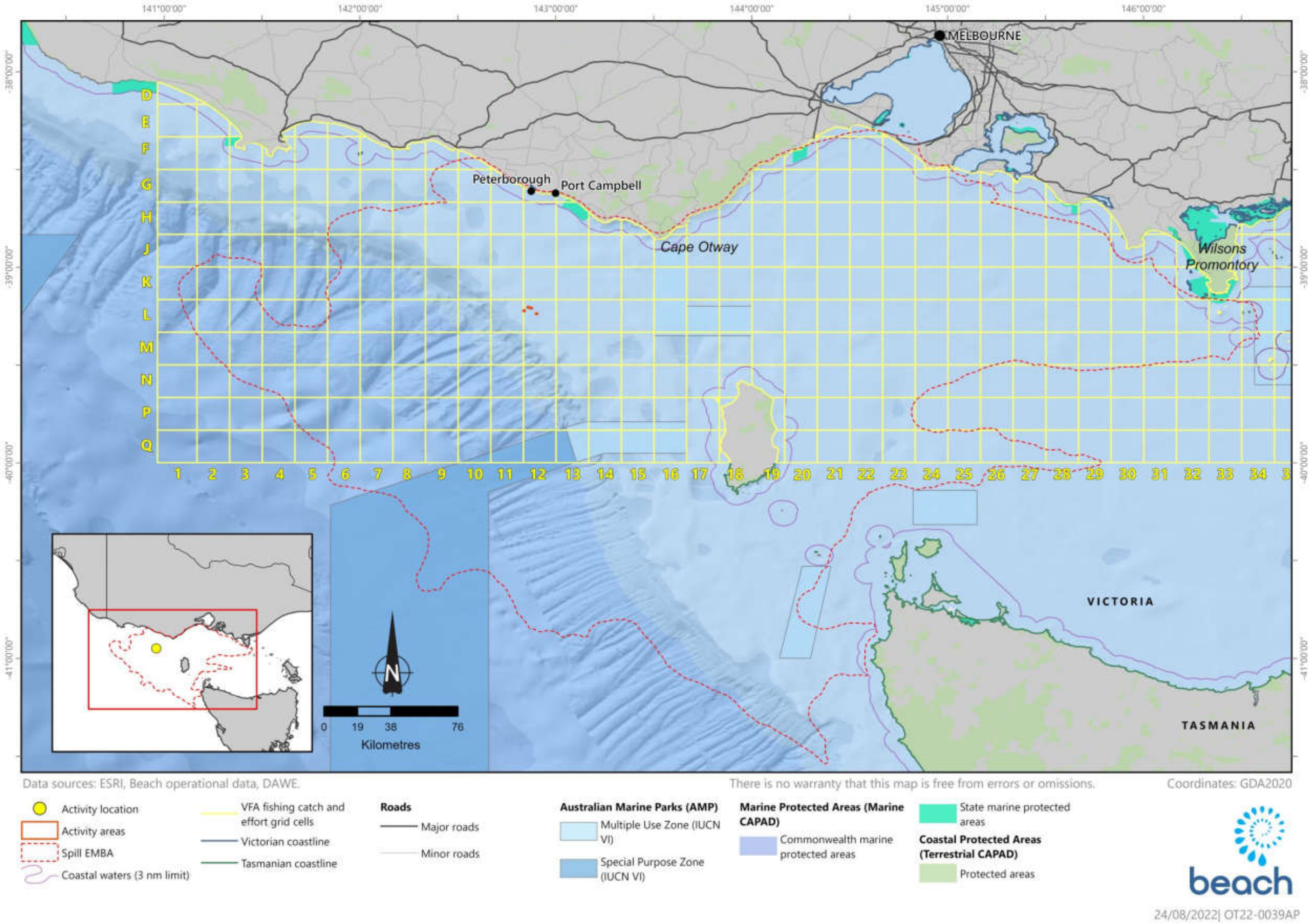


Figure 5-58: VFA fishing catch and effort grid cells overlapped by the activity area and the EMBA

Table 5-28: Victorian managed fisheries in the spill EMBA

Fishery	Target species	Geographic extent of fishery	Fishing in activity area or spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Giant crab (Western Zone) (Figure 5-59)	Giant crab (*Pseudocarcinus gigas*)	The boundaries of the fishery mimic those of the Rock Lobster Fishery, with the majority of fishing intensity based in the Western Zone.	**Activity area?** **No.** **Spill EMBA?** **Yes.** Fishing is concentrated west of Apollo Bay.	Closed season from: Female crabs – 1 June to 15 November to protect females in berry during spawning period. Male crabs – 15 September to 15 November to protect males during their moulting period when soft shells increase their vulnerability.	Fishers target giant crabs using baited rock lobster pots. As of June 2021, there were 9 fishery access licenses.	Catches of giant crab for the last five seasons were: • 2019/20- 11.7 tonnes. • 2018/19 – 9.2 tonnes. • 2017/18 – 9.8 tonnes. • 2016/17 – 10.0 tonnes. • 2015/16 – 10.0 tonnes. .
Rock Lobster Fishery (Figure 5-60)	Southern rock lobster (*Jasus edwardsii*). Very small bycatch of species including southern rock cod (*Lotella* and *Pseudophycis spp*), hermit crab (family *Paguroidea*), leatherjacket (*Monacanthidae spp*) and octopus (*Octopus spp*).	The western zone stretches from Apollo Bay to the Victorian/South Australian border. Rock lobster abundance decreases moving from western Victoria to eastern Victoria. Larval release occurs across the southern continental shelf, which is a high-current area, facilitating dispersal.	**Activity area?** **No.** **Spill EMBA?** **Yes.** Fishing is concentrated west of Apollo Bay.	Closed season for: Female lobsters – 1 June to 15 November to protect females in berry during spawning period. Male lobsters – 15 September to 15 November to protect males during their moulting period when soft shells increase their vulnerability. Catches generally highest from August to January.	Fished from coastal rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep. Baited pots are generally set and retrieved each day, marked with a surface buoy. As of June 2021, there were 71 fishery access licences in the western zone.	The Rock Lobster Fishery is Victoria's most valuable fishery. In the western zone, catches for the last five seasons with available data were: • 2020/21 – 255 tons valued at a little over 12 million. • 2019/20 -222 tonnes valued at 17.46 million. • 2018/19 – 245 tonnes values at $22 million. • 2017/18 – 230 tonnes valued at $18.6 million. • 2016/17 – 209 tonnes valued at $16.5 million.
Bass Strait Scallop Fishery (Victorian zone)	Commercial scallop (*Pecten fumatus*).	Extends 20 nm from the high tide water mark of the entire Victorian coastline (excluding bays and inlets where commercial scallop fishing is prohibited). Management of the Bass Strait Scallop fishery was split between the Commonwealth, Victoria and Tasmania in 1986 under an Offshore Constitutional Settlement, whereby Commonwealth central, Victorian and Tasmanian zones were created.	**Activity area?** **No.** There is no overlap between the activity area and the fishery. **Spill EMBA?** **Yes.** Highest fishing effort is concentrated in the eastern waters of the state, with most vessels launching from Lakes Entrance and Port Welshpool.	12-month season, beginning 1st April. Fishing usually occurs during the winter months, but can occur from May to the end of November. While scallops are still present in the region, they are believed to be present in much lower numbers than historically. Scallops have highly variable levels of natural mortality, with an historical 'boom' or 'bust' nature. Fishing activity in the fishery is currently low, although the VFA is implementing management arrangements designed to increase activity across the fishery.	Towed scallop dredges (typically 4.5 m wide) that target dense aggregations ('beds') of scallop. A tooth-bar on the bottom of the mouth of the dredge lifts scallops from the seabed and into the dredge basket. There are a maximum of 91 licences available with 89 currently assigned. Only a few vessels fishing these licenses operate in any one year (generally between 12 and 20). Vessels are typically based out of Lakes Entrance or Port Welshpool, although licence holders may fish the entire coastline. Some licence holders also have entitlements to fish the Commonwealth scallop fishery, inshore trawl, Commonwealth SESS fishery and the southern squid jig fishery.	Zero quotas were in place for the 2010-11, 2011-12 and 2012-13 seasons due to a lack of commercial scallop quantities. The TACC has been set at 135 tonnes for the 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fishing seasons, and is likely to remain at this level for the foreseeable future. A pre-season survey conducted in 2021, investigated reports of an emerging scallop bed near the Tarwine oil and gas field confirmed that the area was suitable to harvest in. Th survey's findings allowed the total allowable catch for 2022 to increase to 979 tonnes. Scallop spawning normally occurs from late winter to early spring, with larvae drifting as plankton for up to six weeks before first settlement. Juvenile scallops reach marketable size within 18 months.
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) is the primary target, with greenlip abalone (*H. laevigata*) taken as a bycatch.	Victorian Western Abalone Zone is located between the mouth of the Hopkins River and the Victorian/South Australian border. Most abalone live on rocky reefs from the shore out to depths of 30 m.	**Activity area?** **No.** **Spill EMBA?** **Yes.** Based on catch distributed along the Victorian coast.	12-month season, beginning 1st April.	Abalone diving activity occurs close to shoreline (generally no greater than 30 m depth) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel). Commercial divers do not use SCUBA gear. Divers use an iron bar to prise abalone from rocks. The fishery consists of 71 fishery access licences, with 14 in the western zone, 34 in the central zone and 23 in the eastern zone.	In the central zone, catches for the last five seasons were: • 2020/21 – 230 tonnes. • 2019/20 – 233 tonnes. • 2018/19 – 274 tonnes. • 2017/18 – 274 tonnes. • 2016/17 – 280 tonnes.
Wrasse Fishery (Figure 5-61)	Blue-throat wrasse (*Notolabrus tetricus*), saddled wrasse (*N. fucicola*), orange-spotted wrasse (*N. parilus*).	Entire Victorian coastline out to 20 nm (excluding marine reserves, bays and inlets).	**Activity area?** **No.** **Spill EMBA?** **Yes.** In recent years, catches have been highest off the central coast (Port Phillip Heads, Western Port and Wilson's Promontory) and the west coast.	Year-round.	Handline fishing (excluding longline), rock lobster pots (if in possession of a rock lobster access fishing licence). Preferred water depths for blue-throat wrasse is 20-40 m, while saddled wrasse prefer depths of 10-30 m. As of June 2021, there were 22 fishery access licences.	Catches of all wrasse species for the last five seasons were: • 2020/21 – 22 tonnes valued at $224,000. • 2019/20 – 25 tonnes valued at $487,000. • 2018/19 – 33 tonnes valued at $672,000. • 2017/18 – 38 tonnes valued at $767,000. • 2016/17 – 24 tonnes valued at $557,000.

Fishery	Target species	Geographic extent of fishery	Fishing in activity area or spill EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Octopus Fishery (Figure 5-62)	Primarily Pale octopus (*Octopus pallidus*) however, Maori octopus (*Macroctopus maorum* and Gloomy Octopus (*Octopus tetricus*) may also be taken.	Fishing takes place mainly in the eastern zone of Victoria. The western and central zones are less established are being managed via temporary and exploratory permits.	**Activity area?** **Yes.** The western zone does overlap with the activity area; however, it does not intersect the concentrated areas of fishing (eastern zone). **Spill EMBA?** **Yes.** The EMBA overlaps with the western and central zones of the fishery zones, however, it does not intersect areas of high fishing concentrations (the eastern zone).	Year-round	Octopus pots are used. The eastern zone has 11 fishery access licences.	Data for the past 3 fishing seas are available: 2020/21 – 157 tonnes valued at 1.5 million 2019/20- 134 tonnes valued at 1.3 million. 2018/19 – 89 tonnes valued at $908,000
Pipi Fishery	Pipi (*Donax deltoides*)	Entire Victorian coastline, excluding the intertidal zone of Port Phillip Bay and MNPs and sanctuaries where shellfish cannot be harvested. They are found in habitats with high energy surf areas and sandy beaches. In Victoria, there are known harvestable quantities of pipi on beaches in Discovery Bay and surrounds in the west, and in Venus Bay and surrounds in the east.	**Activity area?** **No.** **Spill EMBA?** **No.**	TBC	TBC	Most recent catch data available • 2016/17- approximately 44 tonnes. • 2015/16 – approximately 57 tonnes. • 2014/15 – approximately 83 tonnes. • 2013/14 – approximately 91 tonnes.
Multi-species ocean fishery						
Ocean Purse Seine Fishery	Australian sardine (*Sardinops sagax*), Australian salmon (*Arripis trutta*) and sandy sprat (*Hyperlophus vittatus*) are the main species. Southern anchovy (*Engraulis australis*) caught in some years.	Entire Victorian coastline, excluding marine reserves, bays and inlets.	**Activity area?** **No.** **Spill EMBA?** **Yes.** An assumption, based on limited data availability.	Year-round.	Purse seine is generally a highly selective method that targets one species at a time, thereby minimising bycatch. The purse seine method does not touch the seabed. A lampara net may also be used. Only one licence is active in Victorian waters (based out of Lakes Entrance), with fishing focused close to shore and during the day. This licence is held by Mitchelson Fisheries Pty Ltd, catches primarily sardines, salmon, mackeral, sandy sprat, anchovy and white bait using the *Maasbanker* purse seine vessel.	Confidential data (due to operation of only one fisher).
Ocean Access (or Ocean General) Fishery (Figure 5-61 and Figure 5-63)	Gummy shark (*Mustelus antarcticus*), school shark (*Galeorhinus galeus*), Australian salmon (*Arripis trutta*), snapper (*Pagrus auratus*). Small bycatch of flathead (*Platycephalidae spp*).	Entire Victorian coastline, excluding marine reserves, bays and inlets.	**Activity area?** **No.** **Spill EMBA?** **Yes.** An assumption, based on limited data availability.	Year-round.	Utilises mainly longlines (200 hook limit), but also haul seine nets (maximum length of 460 m) and mesh nets (maximum length of 2,500 m per licence). As of June 2020, there were 157 fishery access licences. Fishing usually conducted as day trips from small vessels (<10 m).	There is insufficient catch data (catch data is combined with other fisheries and therefore unable to be distinguished on a standalone basis).
Inshore Trawl Fishery	Key species are eastern king prawn (*Penaeus plebejus*), school prawn (*Metapenaeus macleayi*) and shovelnose lobster/Balmain bug (*Ibacus peronii*). Minor bycatch of school whiting (*Sillago bassensis*) and gummy shark (*Mustelus antarcticus*).	Entire Victorian coastline, excluding marine reserves, bays and inlets. Most operators are based at Lakes Entrance.	**Activity area?** **No.** **Spill EMBA?** **Yes.** Based out of Lakes Entrance with catch locations being distant from the spill EMBA.	Year-round, although the majority of prawn fishing occurs in the warmer months up until Easter.	Otter-board trawls with no more than a maximum head- line length of 33 m, or single mesh nets are used. As of June 2019, there were 54 fishery access licences, with only about 15 active to various degrees.	The catch of eastern school prawn in 2015 was 75 t, the largest for the previous 10 years.

Source: VFA (2021).

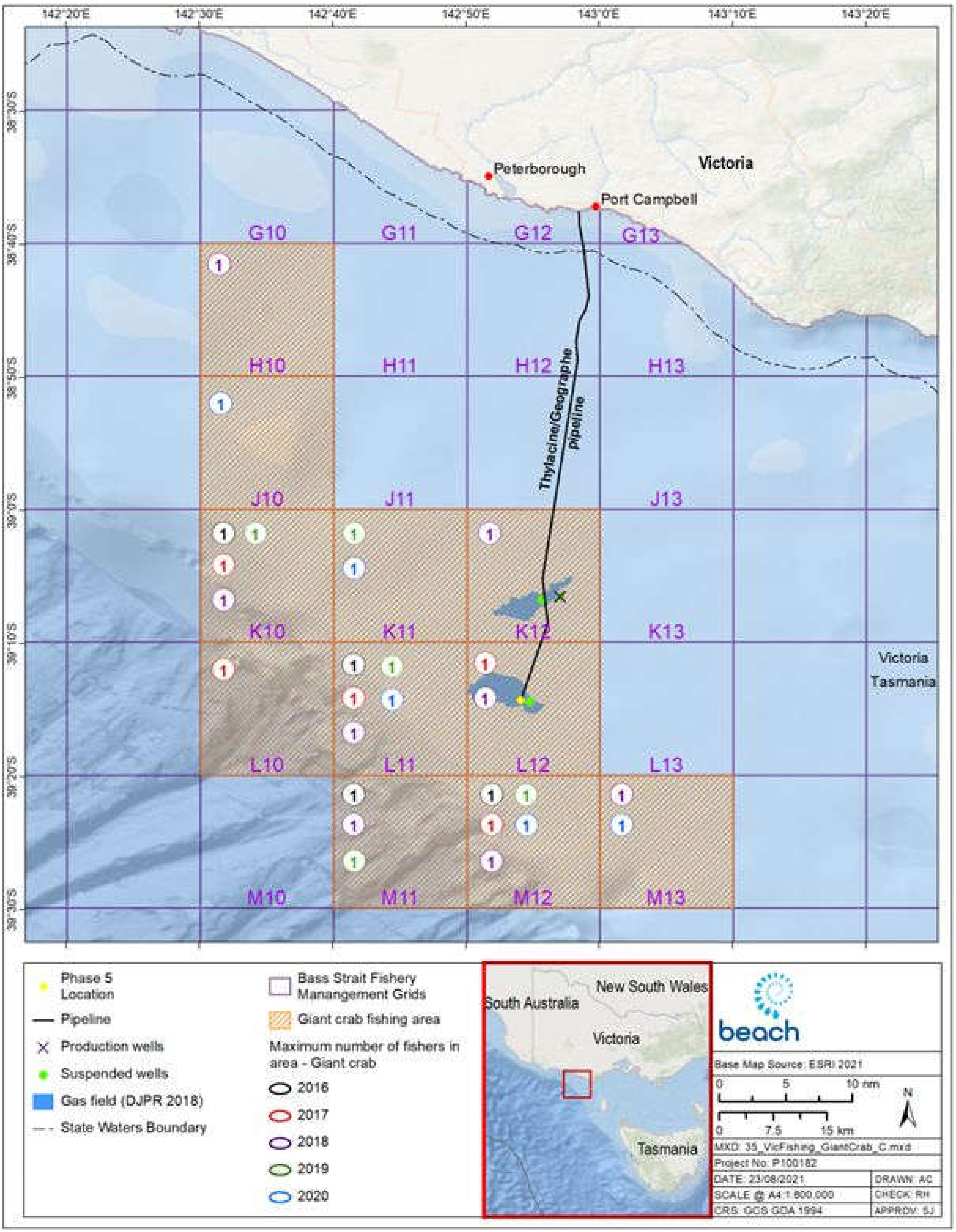


Figure 5-59: Maximum number of giant crab fishers in the region from 2016-2020 (VFA, 2021)

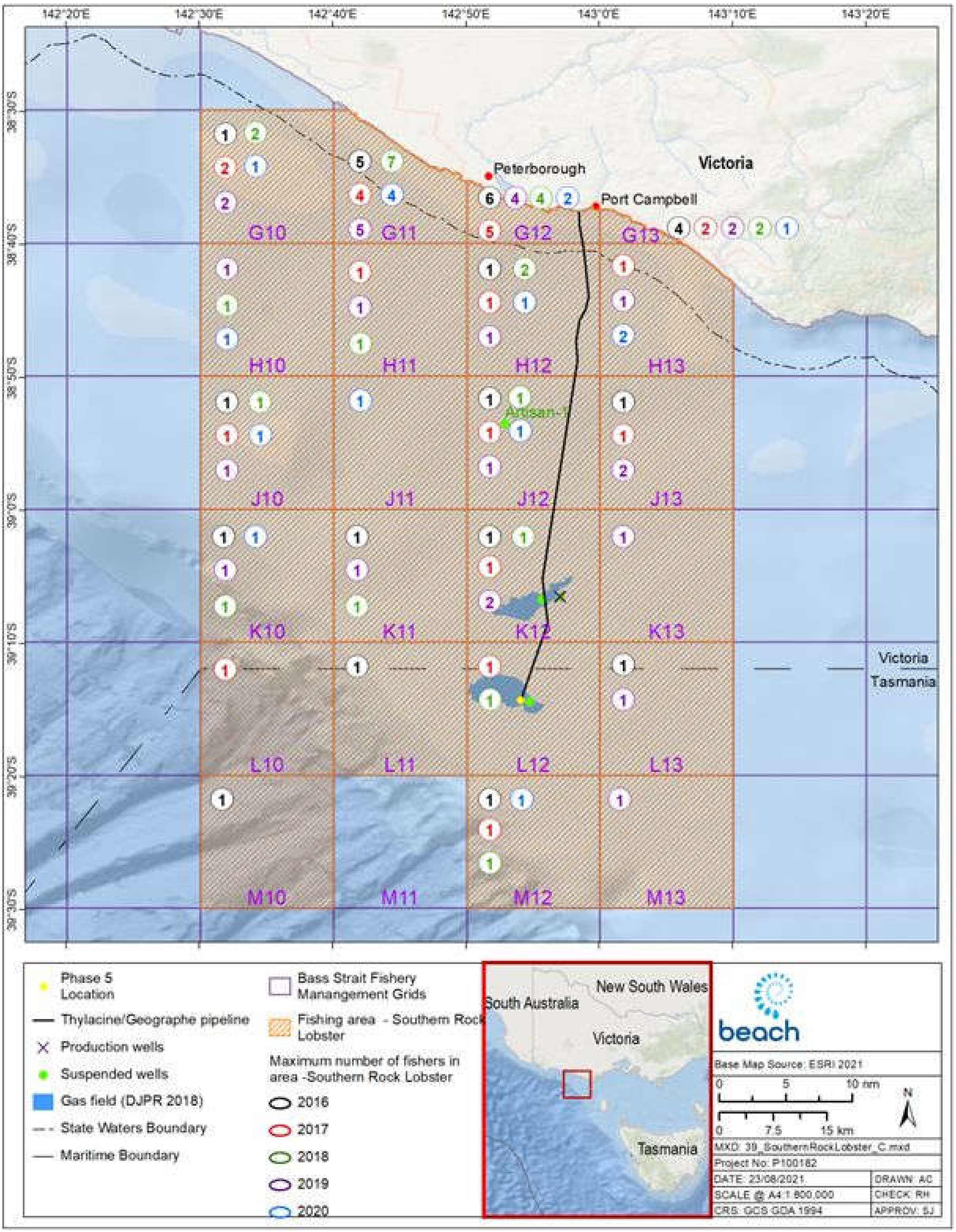


Figure 5-60: Maximum number of southern rock lobster fishers in the region from 2016-2020 (VFA, 2021)

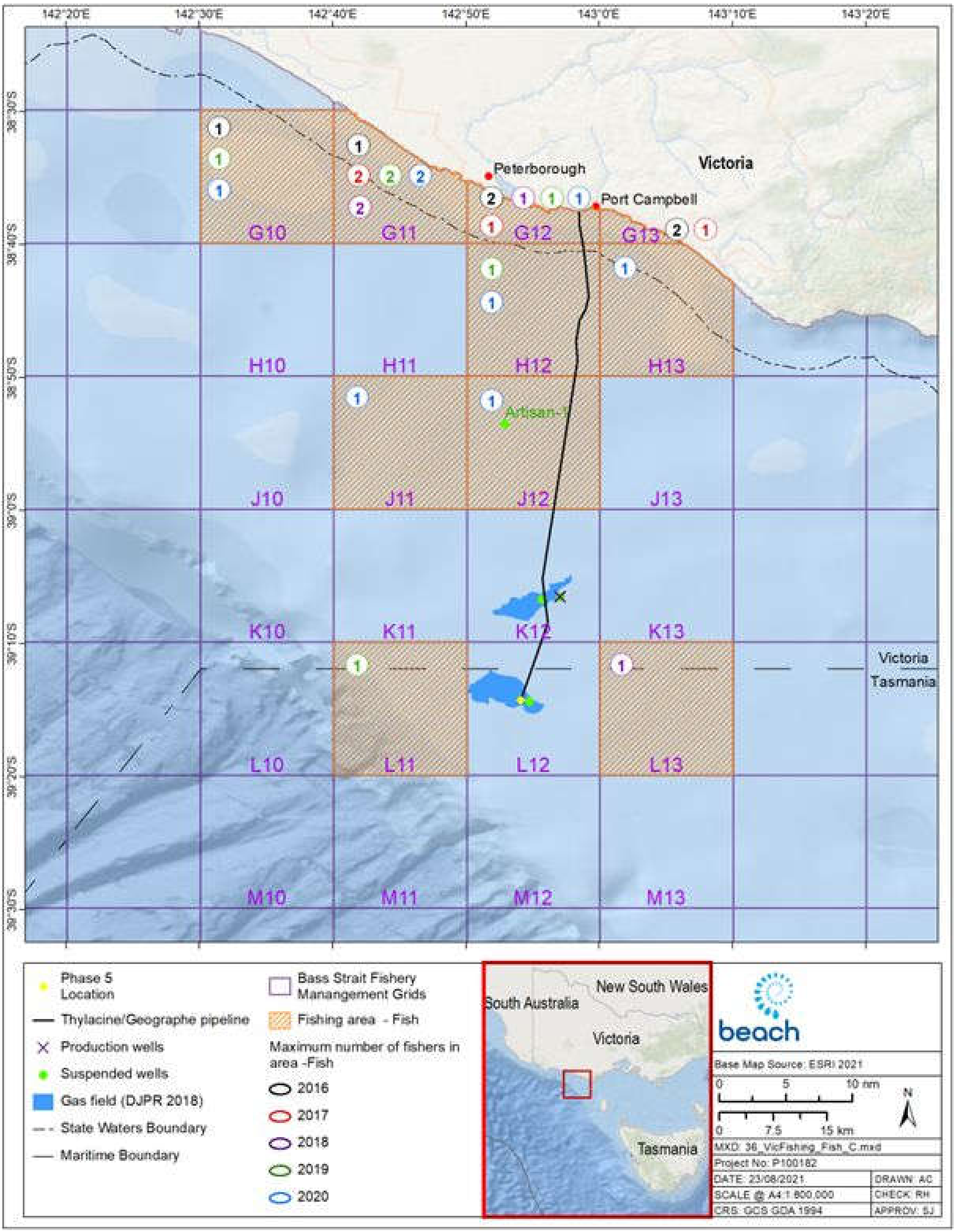


Figure 5-61: Maximum number of fish fishers (eel, snapper and wrasse) in the region from 2016-2020 (VFA, 2021)

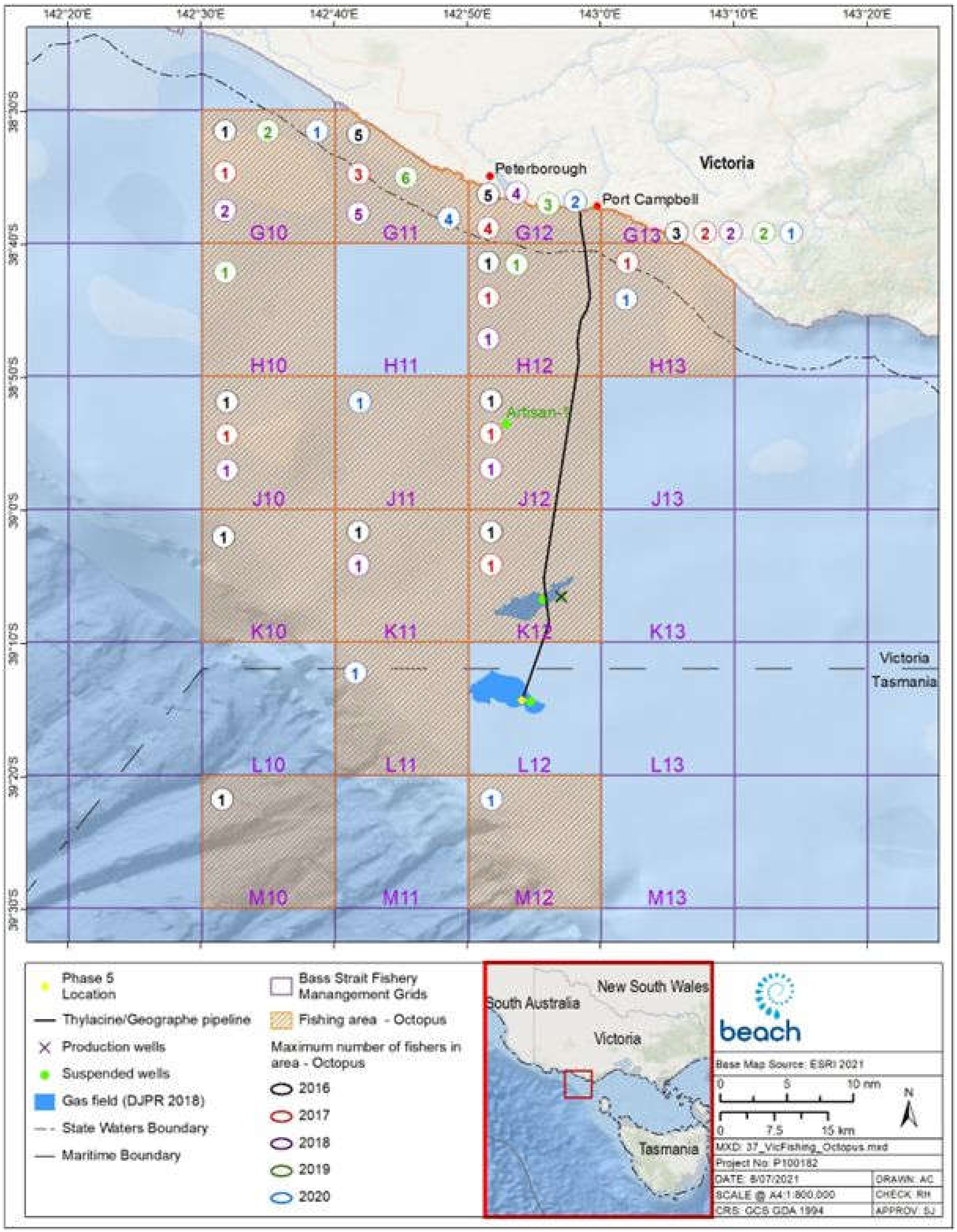


Figure 5-62: Maximum number of octopus fishers in the region from 2016-2020 (VFA, 2021)

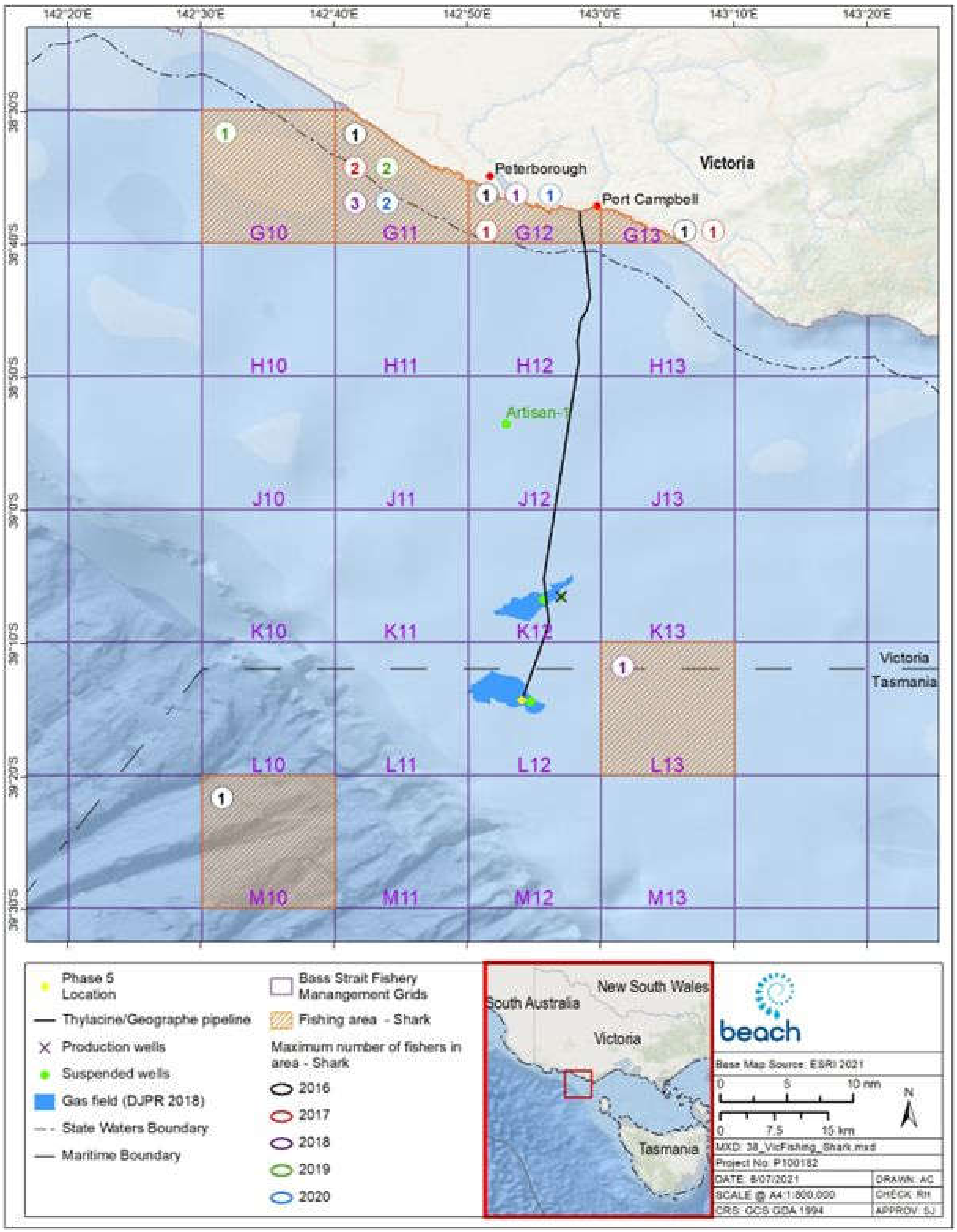


Figure 5-63: Maximum number of shark fishers in the region from 2016-2020 (VFA, 2021)

5.6.7.3 Tasmanian managed fisheries

No Tasmanian fisheries were identified within the activity area. The Tasmanian state managed commercial fisheries that occur within the spill EMBA:

- Octopus Fishery
- 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 5-29.

Table 5-29: Tasmanian managed fisheries in the spill EMBA

Fishery	Target species	Geographic extent of fishery	Fishing in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Octopus Fishery (Figure 5-64)	Pale octopus (*Octopus pallidus*).	Entire Tasmanian coastline.	**Activity area? No.** **Spill EMBA? Yes.**	Year round.	There are only two active vessel licences.	From the reporting grids overlapping the EMBA, 0.1 – 2 tonnes were caught from 2013/14 to 2017-18.
Scalefish Fishery (Figure 5-64)	Multi-species including banded morwong (*Cheilodactylus spectabilis*), tiger flathead (*Neoplatycephalus richardsoni*), southern school whiting (*Sillago flindersi*) Australian salmon (*Arripis trutta*), barracouta (*Thyrsites atun*), bastard trumpeter (*Latridopsis forsteri*) and blue warehou (*Seriolella brama*).	Entire Tasmanian coastline.	**Activity area? No.** **Spill EMBA? Yes.** The EMBA intersects areas of reported catch from the northwest and northeast sectors, based on the fishery's 2017/18 assessment report.	Year-round. Some seasonal closures depending on the target species.	The fishery targets multiple species and therefore uses multiple gear-types including drop-line, Danish seine, fish trap, hand-line and spear. There were 259 vessels operating in 2017/18 across the fishery.	Available data of catches for five seasons include: 2017/18 – 318 t. 2016/17 – 312 t. 2015/16 – 348 t. 2014/15 – 273 t. 2013/14 – 320 t.
Commercial Dive Fishery (Figure 5-65)	Short spined sea urchin (*Heliocidaris erythrogramma*), long spined sea urchin (*Centrostephanus rodgersii*), periwinkles (*Turbo*), Japanese kelp (*Undaria pinnatifida*).	Entire Tasmanian coastline (refer to Figure 5.53).	**Activity area? No.** **Spill EMBA? Yes**	1 September – 31 August.	There are currently 52 commercial dive licences.	Historic catch data is not available.
Scallop Fishery	Commercial scallop (*Pecten fumatus*).	Entire Tasmanian coastline	**Activity area? No.** Fishery currently closed. **Spill EMBA? No.** Fishery currently closed.	Fishery closed.	Towed scallop dredges (typically 4.5 m wide) that target dense aggregations ('beds') of scallop. A tooth-bar on the bottom of the mouth of the dredge lifts scallops from the seabed and into the dredge basket.	Closed since 2016.
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) is the primary target, with greenlip abalone (*H. laevigata*) taken as a bycatch.	Entire Tasmanian coastline including King Island and the Furneaux Group.	**Activity area? No.** **Spill EMBA? Yes**	Year-round.	Abalone diving activity occurs close to shoreline (generally no greater than 30 m depth) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel). Commercial divers do not use SCUBA gear. Divers use an iron bar to prise abalone from rocks.	Available data of catches for five seasons include: 2018 – 1,310 t. 2017 – 1,561 t. 2016 – 1,694 t. 2015 – 1,855 t. 2014 – 1,932 t.
Rock Lobster Fishery	SRL (*Jasus edwardsii*).	All Tasmanian waters. East Coast Stock Rebuilding Zone subject to temporary closures.	**Activity area? No.** **Spill EMBA? Yes**	Female - 1 May 2018 for all State waters. Male - 1 September 2018 for all waters south of St Helens around to Sandy Cape. 1 October 2018 all other waters.	Fished from coastal rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep. Baited pots are generally set and retrieved each day, marked with a surface buoy. There were 194 licenced vessels in 2017/18.	Available data of catches for five seasons include: 2018/19 – 1,050 t. 2017/18 – 1,050 t. 2016/17 – 1,050 t. 2015/16 – 1,050 t. 2014/15 – 1,050 t.
Shellfish Fishery	Pacific oyster (*Crassostrea gigas*), Native oyster (*Ostrea angasi*), Venerupis clam (*Venerupis largillierti*) and Katelysia cockle (*Katelysia scalarina*).	Designated zones occur at Georges Bay and Ansons Bay on the east coast of Tasmania.	**Activity area? No.** **Spill EMBA? No.**	Year-round (assumed).	The shellfish targeted by the fishery can be collected by hand in shallow water using a basket rake. In deeper water a dredge is used.	Available data of catches for five seasons include: 2014/15 – 25 t. 2013/14 – 42 t. 2012/13 – 49 t. 2011/12 – 44 t. 2010/11 – 44 t.
Seaweed Fishery	Bull kelp (*Nereocystis luetkeana*) and Wakame (*Undaria pinnatifida*).	Kelp harvesting occurs on the west coast of Tasmania and King Island. *Undaria pinnatifida* harvesting occurs on the east coast of Tasmania.	**Activity area? No.** **Spill EMBA? Yes** Primary sites off the east coast of Tasmania and west coast of King Island.	Year-round (assumed).	Seaweeds are harvested as they wash ashore. The collection of native seaweed species if they are attached to substrate or the sea is prohibited. Bull kelp is dried and alginates are extracted which are used in thickening solutions. Some is bagged and sold as garden mulch.	No catch data available.
Giant Crab Fishery	Tasmanian giant crab (*Pseudocarcinus gigas*).	Entire Tasmanian coastline, the fishery shares the same reporting grid as the rock lobster fishery.	**Activity area? No.** There is no overlap between the fishery and the activity area. **Spill EMBA? Yes** The majority of catch occurs off the south western, southern and south eastern coast of Tasmania along the continental slope.	Males – year-round. Females – 15 Nov to 31 May.	Giant crabs are harvested on the continental shelf, with the most abundant catches at water depths of 110-180 m. They are harvested via baited pots.	Catches for the last five seasons were: 2018/19 – 20 t. 2017/18 – 16 t. 2016/17 – 30 t. 2015/16 – 20 t. 2014/15 – 23 t.

Source: DPIPWE (2020a-h), Moore & Hartmann (2019), Emery et al (2015), Hill et al (2020).

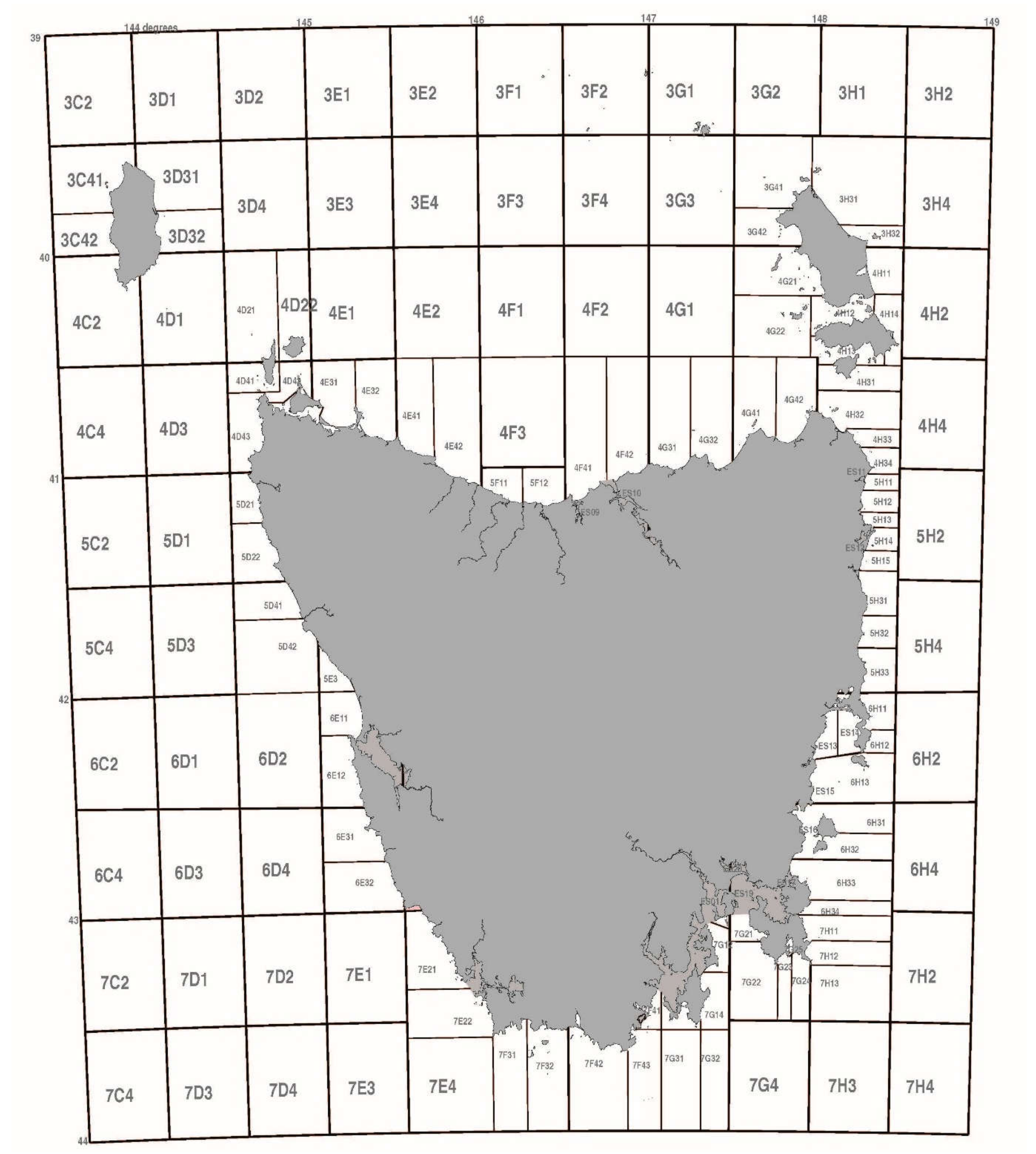


Figure 5-64: Jurisdiction and zones of the Tasmanian Scalefish Fishery and Octopus Fishery

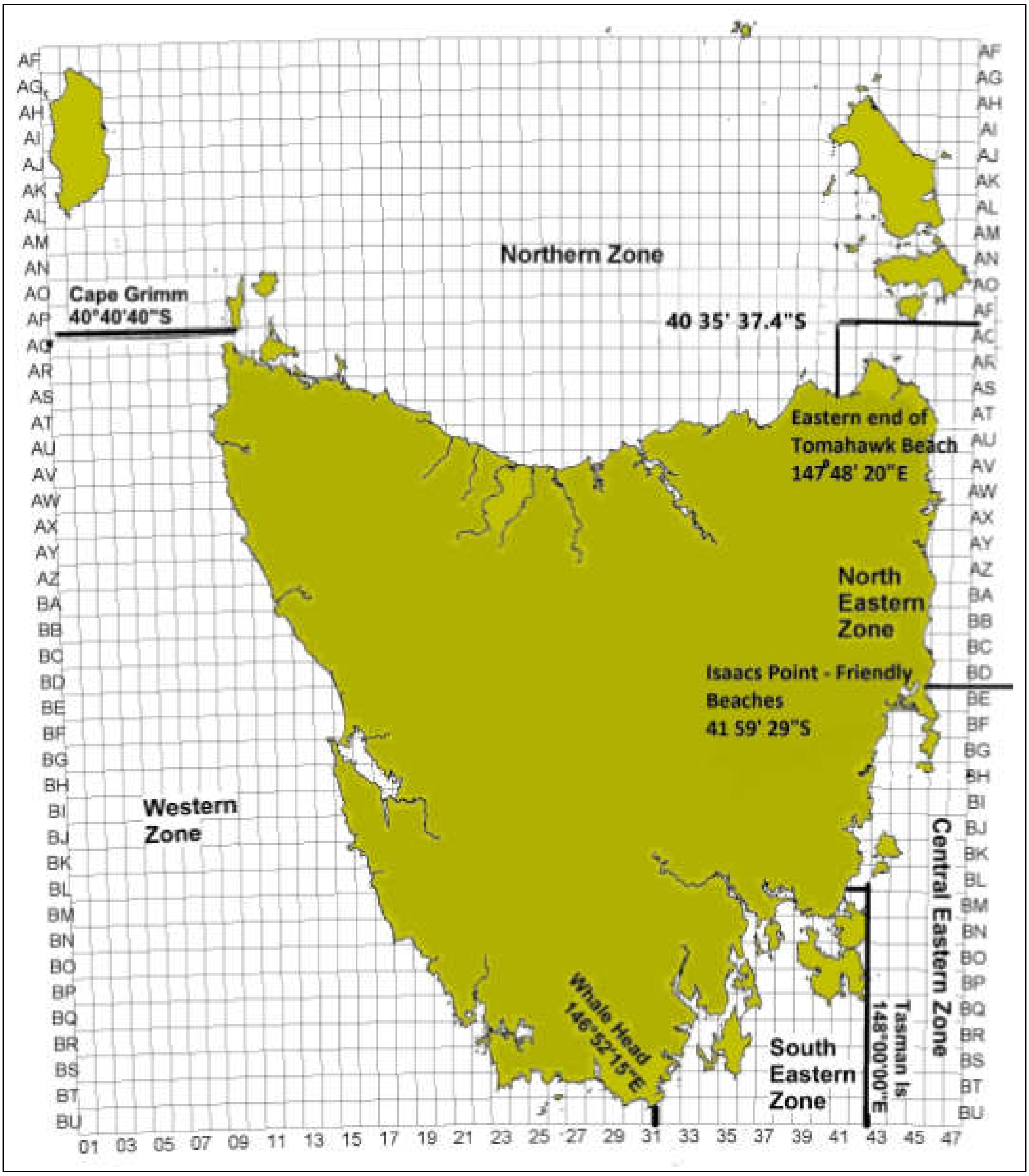


Figure 5-65: Jurisdiction of the Tasmanian Commercial Dive Fishery

5.7 Cultural environment

5.7.1 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 Costal 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 activity area. It must be assumed that sites will be scattered along the coast of King Island within the spill EMBA.

5.7.2 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.

5.7.3 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).

A search of the Australasian Underwater Cultural Heritage Database indicates there are over 150 historic wrecks in the spill EMBA (Figure 5-66). 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 activity 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 5-13. 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.

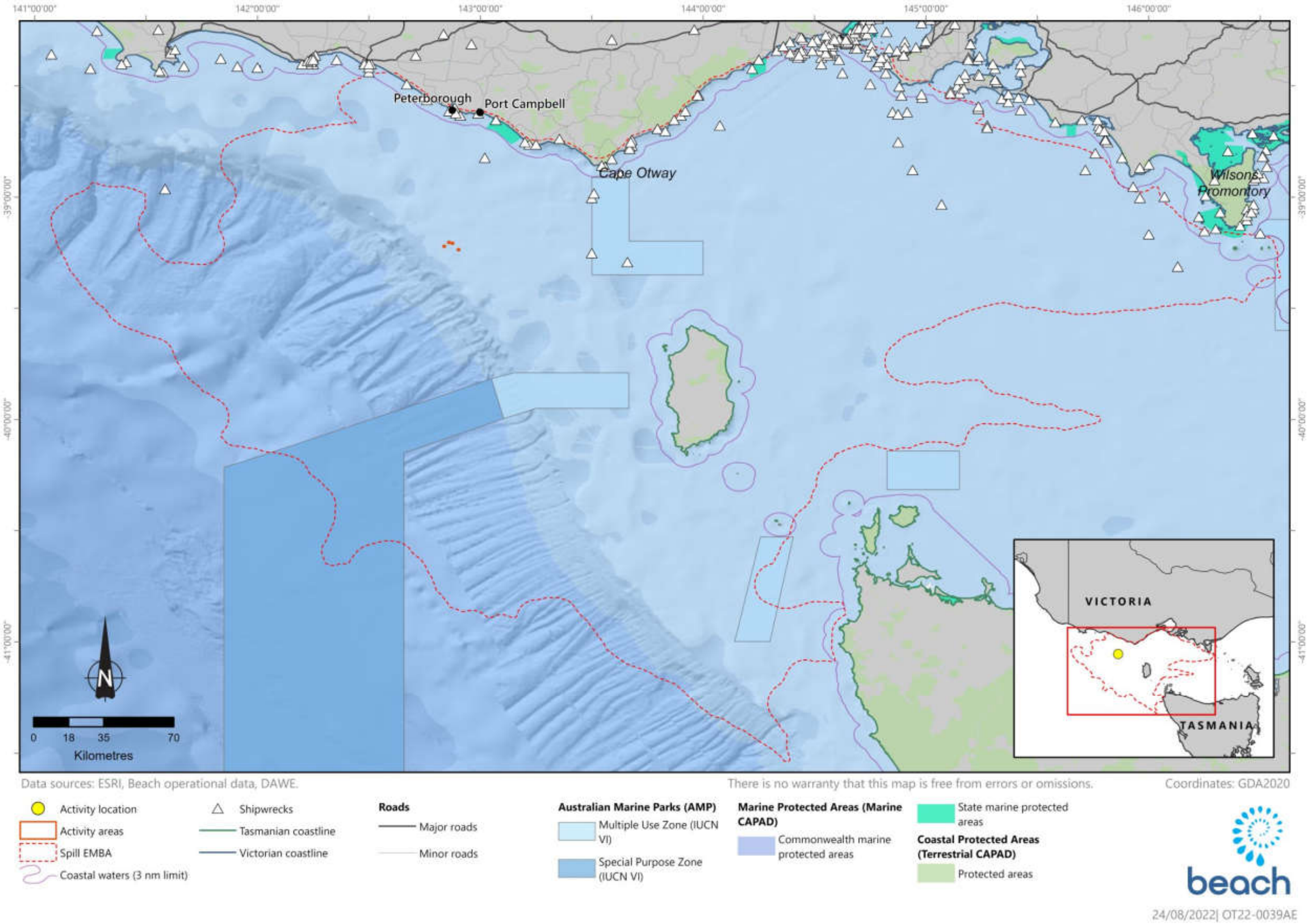


Figure 5-66: Known shipwrecks in the activity area and spill EMBA

6 Environmental Impact and Risk Assessment Methodology

As required under Regulation 13(5) of the OPGGS(E), this chapter describes the environmental impact and risk assessment methodology used in this EP. Beach uses its Corporate Risk Assessment Framework as per the Risk Management Standard (CDN/ID 18985348) to mitigate and manage risks for all its activities. The Risk Management Standard is part of Element 8 – Risk Management and Hazard Control, a component of the Beach Operations Excellence Management System (OEMS) (see Chapter 8).

The Corporate Risk Management Framework methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, Risk Management – Principles and Guidelines). Figure 6-1 outlines this risk assessment process. Definitions of the term used in the risk assessment process are detailed in Table 6-1.

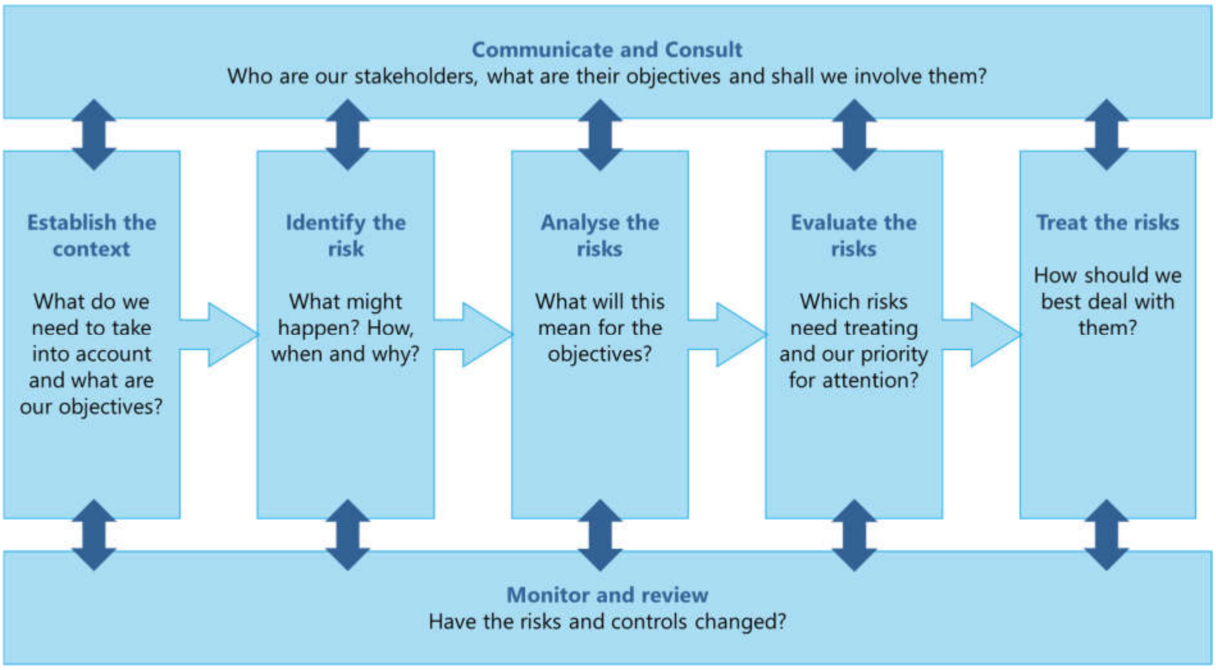


Figure 6-1: Risk assessment process

Table 6-1: Risk assessment process definitions

Term	Definition
Activity	Refers to a 'petroleum activity' as defined under the OPGGS(E)R as: petroleum activity means operations or works in an offshore area undertaken for the purpose of: exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or, discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act.
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).

6.1 Step 1 – 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 activity 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 Chapter 4.

6.2 Step 2 – Establish the Content

Context for the risk assessment process is established by:

- Understanding the regulatory framework in which the activity takes place (described in the 'Regulatory Framework' in Chapter 2);
- Defining the activities that will cause impacts and create risks (outlined in the 'Activity Description' in Chapter 3);
- Understanding the concerns of stakeholders and incorporating those concerns into the design of the activity where appropriate (outlined in Chapter 4, 'Stakeholder Consultation'); and
- Describing the environment in which the activity takes place (the 'Existing Environment' is described in Chapter 5).

Once the context has been established, the hazards of the activity can be identified, along with the impacts and risks of these hazards.

6.3 Step 3 – Identify the Impacts and Risks

Beach's Corporate Risk Assessment Framework requires the following steps to be implemented:

- Identify the activities and the potential impacts associated with them;
- Identify the sensitive environmental resources at risk within and adjacent to the activity area;
- Identify the environmental consequences of each potential impact, corresponding to the maximum reasonable impact;
- Identify the likelihood (probability) of occurrence of each potential environmental impact (i.e., the probability of the event occurring);
- Identify applicable control measures; and
- Assign a level of risk to each potential environmental impact using a risk matrix.

In its *Environment plan content requirements* guidance note (N-04750-GN1344, September 2020c), NOPSEMA distinguishes between environmental impacts and risks. Environmental impact is defined in accordance with Regulation 4 the OPGGS(E) as any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity of a titleholder.

For this activity, Beach has determined that impacts and risks are defined as follows:

- **Impacts** result from **planned events** – there *will* be consequences (known or unknown) associated with the event occurring. Impacts are an inherent part of the activity. For example, acoustic discharges are an impact on the environment which cannot be avoided for the activity to have purpose.
  - For impacts, only a consequence is assigned (likelihood is irrelevant given that the event does occur).
- **Risks** result from **unplanned events** – there *may* be consequences if an unplanned or emergency event occurs. Risks are not an inherent part of the activity. For example, a hydrocarbon spill may occur if the activity vessel collides with another vessel, but this is not a certainty. The risk of this event is determined by multiplying the consequence of the impact (using factors such as the type and volume of hydrocarbons and the nature of the receiving environment) by the likelihood of this event happening (which may be determined objectively or subjectively, qualitatively or quantitatively).
  - For risks, the consequence and likelihood are combined to determine the risk rating.

An environmental impact identification (ENVID) workshop was held on 22 July 2022 to identify potential impacts and risks arising from the proposed activity. An environmental impact and risk register was developed and is updated as required.

6.4 Step 4 – Analyse the 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.

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.

6.5 Step 5 – Evaluate the Impacts and Risks

The purpose of impact and risk evaluation (herein referred to simply as risk assessment) is to assist in making decisions, based on the outcomes of analysis, about the sorts of controls required to reduce an impact or risk to ALARP. Planned and unplanned events are subject to risk assessment in the same manner.

Beach's risk assessment process is described below and was followed in the risk identification and assessment workshop described in Section 6.3. The following steps are undertaken using the Beach OEMS Element 8, BSTD 8.1 Risk Management Standard, Risk Matrix (Table 6-2) to evaluate the potential impacts and risks:

- Identify and describe the impacts and risks (see Chapter 7).
- Inherent risk is determined from the maximum credible consequence (to the natural environment and community/social/cultural heritage) arising from the impact or risk without introducing additional controls. This determination is provided in the risk assessment tables throughout Chapter 7. For unplanned events (risks):
  - identify the likelihood (probability) of unplanned environmental impacts occurring.
  - assign a level of risk to each potential environmental impact using the risk matrix.
  - multiply the consequence and likelihood to determine the overall risk raking.
- Identify control measures to manage potential impacts and risks to as low as reasonably practicable (ALARP) (Section 6.6.1) and an acceptable level (Section 6.6.2).
- Residual risk is determined by undertaking an assessment of the likelihood of occurrence and the consequence of the impact or risk, corresponding to the maximum credible impact across the consequence categories considering the controls identified and their effectiveness.

  Establish environmental performance standards for each of the identified control measures.

Table 6-2: Environmental risk assessment matrix

CDN 14740489 Beach Risk Matrix & Risk Management Quick Reference Guide

Risk Matrix

CONSEQUENCE	CONSEQUENCE CATEGORY: PEOPLE	ENVIRONMENT	REPUTATION	FINANCIAL	LEGAL	LIKELIHOOD: A. Remote	B. Highly Unlikely	C. Unlikely	D. Possible	E. Likely	F. Almost Certain
	Impact to Beach or contracting personnel	Natural environment	Community safety, reputation/social licence. media, items of cultural significance.	Financial impact (e.g. due to loss of revenue, business interruption, asset loss etc.)	E.G. Breach of law, prosecution, civil action	<1% chance of occurring within the next year. Requires exceptional circumstances, unlikely event in the long-term future. Only occur as a 100-year event	> 1% chance of occurring within the next year. May occur but not anticipated. Could occur years to decades	> 5% chance of occurring within the next year. May occur but not for a while. Could occur within a few years	>10% chance of occurring within the next year. May occur shortly but a distinct probability it won't. Could occur within months to years	>50% chance of occurring within the next year. Balance of probability will occur. Could occur within weeks to months	99% chance of occurring within the next year. Impact is occurring now. Could occur within days to weeks
6 Catastrophic	Multiple fatalities >4 or severe irreversible disability to large group of people (>10)	Catastrophic offsite or onsite release or spill; long-term destruction of highly significant ecosystems; significant effects on endangered species or habitats; irreversible or very long-term impact	Multiple community fatalities; complete loss of social licence; prolonged negative national media; complete loss of items of cultural significance	> AUD$500m	Prolonged and complex civil and/or regulatory litigation; potential jail terms and/or very high fines and/or damages claim	HIGH	HIGH	SEVERE	SEVERE	EXTREME	EXTREME
5 Critical	1-3 fatalities or serious irreversible disability (>30%) to multiple persons (<10)	Significant offsite or onsite release or spill; eradication or impairment of the ecosystem; significant impact on highly valued species or habitats; widespread long-term impact	Community fatality; significant loss of social licence; negative national media for 2 or more days; significant damage to items of cultural significance	>AUD$100m & ≤ $500m	Civil and/or regulatory litigation; potential significant fines and/or damages claim	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE	EXTREME
4 Major	Serious permanent injury/ illness or moderate irreversible disability (<30%) to one or more persons	Major Offsite or onsite release or spill; very serious environmental effects, such as displacement of species and partial impairment of ecosystem; major impact on highly valued species or habitats; widespread medium and some long-term impact	Serious permanent injury to community member; major damage to social licence; negative national media; major damage to items of cultural significance	>AUD$10m & ≤ $100m	Civil and/or regulatory litigation; potential major fine and damages claim	MEDIUM	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE
3 Serious	Serious reversible/ temporary injury/illness; Lost Time Injury >5 days or Alternate/Restricted Duties > 1 month	Minor offsite or onsite release or spill; serious short-term effect to ecosystem functions; serious impact on valued species or habitats; moderate effects on biological or physical environment	Serious reversible injury to community member; serious damage to social licence; negative state media; serious damage to items of cultural significance	>AUD$1m & ≤$10m	Serious potential breach of law; report and investigation by regulator; possible prosecution or regulatory notice (e.g. improvement notice or equivalent), or possible civil litigation and serious damages claim	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	SEVERE
2 Moderate	Reversible temporary injury/ illness requiring Medical Treatment; Lost Time Injury ≤5 days or Alternate/Restricted Duties for ≤ 1 month	Event contained within site; short-term effects but not affecting ecosystem functions; some impact on valued species or habitats; minor short-term damage to biological and/or physical environment	Moderate injury to community member; moderate impact to social licence; negative local media; moderate damage to items of cultural significance	>AUD$100,000 & ≤ $1m	Potential Breach of law or non-compliance; inquiry by a regulator leading to Low-level legal issues; possible civil litigation and moderate damages claim	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
1 Minor	First Aid Injury/illness	Spill limited to release location; minor effects but not affecting ecosystem functions; no impact on valued species or habitats; low-level impacts on biological and physical environment	Minor injury to community member, public concern restricted to local complaints, minor damage to items of cultural significance	≤AUD$100,000	Minor potential breach of law; not reportable to a regulator; on the spot fine or technical non-compliance	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

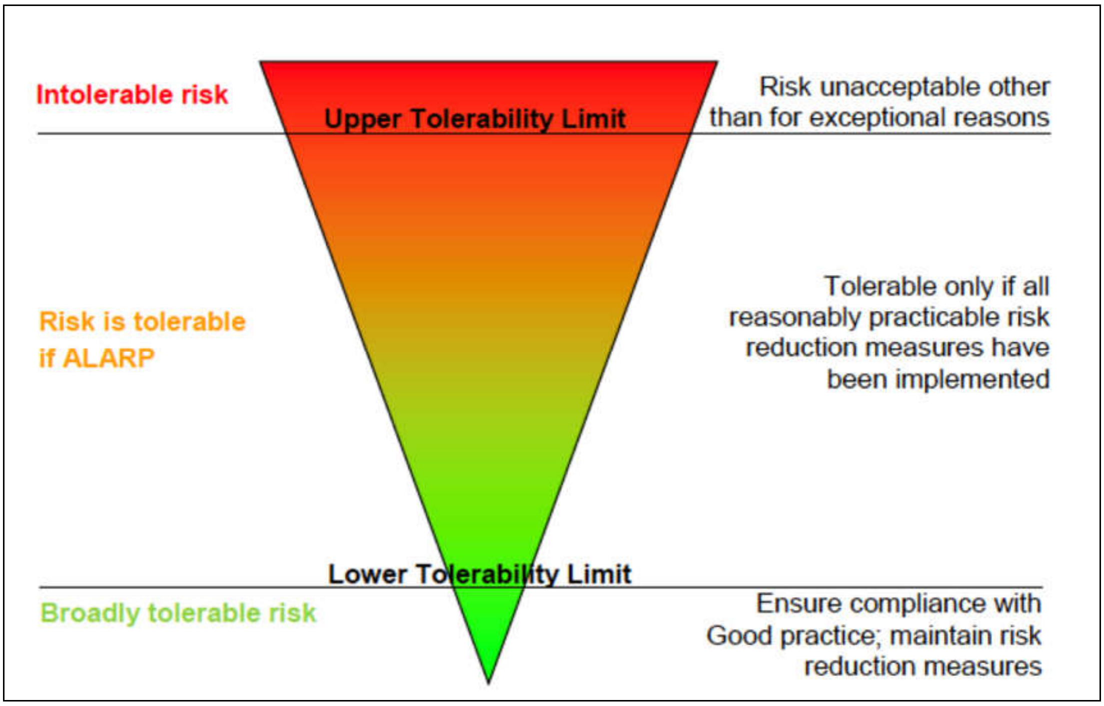
6.6 Step 6 – Treat the Impacts and Risks

The environmental impact and risk register (discussed in Section 6.3) records the environmental control measures (e.g., measures to prevent, minimise and mitigate impacts and risks) that were determined by an expert team familiar with the activity and the sensitivities of the existing environment. These controls are listed throughout the EIA and ERA tables in Chapter 7.

The impacts and risks must be ALARP and acceptable.

6.6.1 Demonstration of ALARP

The ALARP principle states that it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent attempting to reduce an impact or risk to zero. This concept is shown diagrammatically in Figure 6-2.



Source: CER (2015).

Figure 6-2: The ALARP Principle

Beach's approach to demonstrating ALARP includes:

- Systematically identifying and assessing all potential environmental impacts and risks associated with the activity;
- Where relevant, applying industry 'good practice' controls to manage impacts and risks;
- Assessing the effectiveness of the controls in place and determining whether the controls are adequate according to the 'hierarchy of controls' principle; and
- For higher order impacts and risks, implementing further controls if feasible and reasonably practicable to do so.

NOPSEMA's Environment Plan decision making guideline (N-04750-GL1721, June 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.

There is no universally-accepted guidance to applying the ALARP principle to environmental assessments. For this EP, the guidance provided in NOPSEMA's Environment Plan decision making guideline has been applied, and augmented where deemed necessary.

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.

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 is outlined in Table 6.3.

Table 6-3: Alignment of ALARP with impacts (using consequence ranking) and risks (using risk ranking)

Consequence ranking	**Minor**	**Moderate**	**Serious**	**Major**	**Critical**	**Catastrophic**
ALARP level – planned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual impact category	Lower order		Higher order			
Risk ranking	Low	Medium	High	Severe	Extreme	
ALARP level - unplanned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual risk category	Lower order risks			Higher order risks		

When deciding on whether to implement the proposed impact/risk reduction measure, the following issues are considered:

- Does it provide a clear or measurable reduction in risk?
- Is it technically feasible and can it be implemented?
- Will it be supported and utilised by site personnel?
- Is it consistent with national or industry standards and practices?
- Does it introduce additional risk in other activity areas (e.g., will the implementation of an environmental risk reduction measure have an adverse impact on safety)?
- Will the change be effective, taking into account the:
    - Current level of risk with the existing controls;
    - Amount of additional risk reduction that the control will deliver;
    - Level of confidence that the risk reduction impact will be achieved; and
    - Resources, schedule and cost required to implement the control.

Reducing impacts and risks to ALARP is an ongoing process and new risk reduction measures may be identified at any time, including during operations. Beach actively encourages recording and review of observations through the HSE management system (HSEMS) in the incident management system (CMO database). Incidents and lessons learned within Beach and from the wider industry are reviewed and utilised to identify hazards and controls.

The following section details how the guidance provided in NOPSEMA's Environment Plan decision making guideline (N-04750-GL1721, June 2021) is applied.

6.6.1.1 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 6.6.1.2 – Good practice) is sufficient to manage the impact or risk to ALARP.

Higher-order environmental impacts and risks

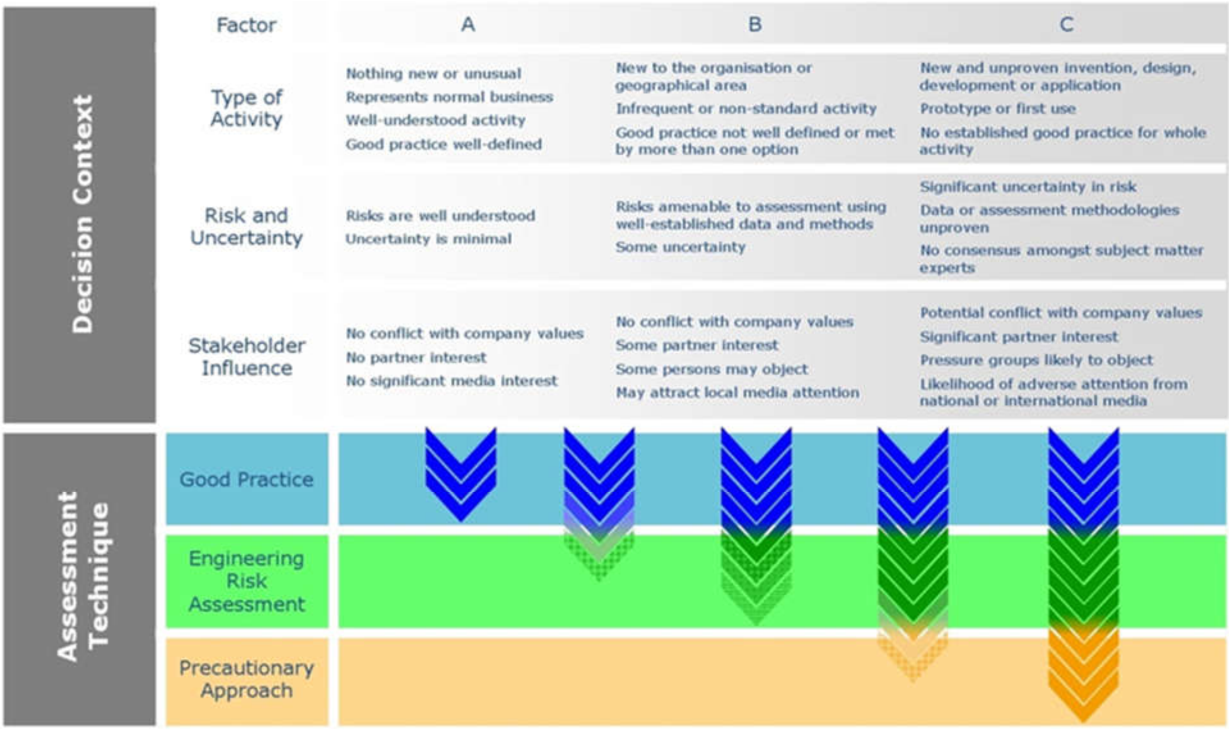
All other impacts and risks are defined by NOPSEMA as higher-order environmental impacts and risks (i.e., where the environment or receptor is formally managed, vulnerable, restricted in distribution, protected or threatened and there is little confidence in the effectiveness of adopted control measures).

Impacts and risks are considered to be higher-order when, using the environmental risk assessment matrix (Table 6-2), 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 6.6.1.2.

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 6-3.

6.6.1.2 Uncertainty of impacts and risks

Based upon the level of uncertainty associated with the impact or risk, the following framework, adapted by NOPSEMA (2015) from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) (Figure 6.4) provides the decision-making framework to establish ALARP (Figure 6-3).



Source: CER (2015).

Figure 6-3: OGUK (2014) decision support framework

This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). The decision type is selected based on an informed decision around the uncertainty of the risk. Decision types and methodologies to establish ALARP are outlined in Table 6-4.

Table 6-4: ALARP decision-making based upon level of uncertainty

Decision type	Decision-making tools
A	Good industry practice Identifies the requirements of legislation, codes and standards that are to be complied with for the activity. Applies the 'Hierarchy of Controls' philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks. Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards.
B	*In addition to decision type A:* Engineering risk-based tools Engineering risk-based tools to assess the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.
C	*In addition to decision type A and B:* Precautionary Principle Application of the Precautionary Principle is to be applied when good industry practice and engineering risk-based tools fail to address uncertainties.

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.

Good practice also requires that hazard management is considered in a hierarchy, with the concept being that it is inherently safer to eliminate a hazard than to reduce its frequency or manage its consequences (CER, 2015). This being the case, the 'Hierarchy of Controls' philosophy is applied to reduce the risks associated with hazards (Figure 6-4).

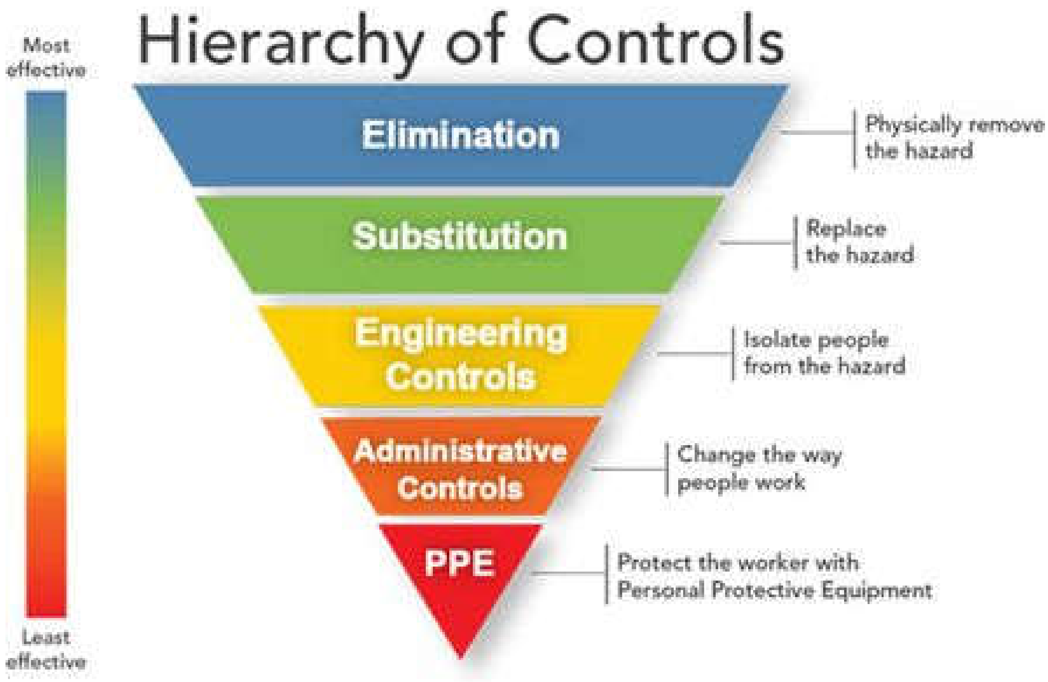


Figure 6-4: The Hierarchy of Controls

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.

Precautionary approach

All impacts and risks that do meet decision type A or type B and require assessment beyond that of good practice and engineering risk assessment are subject to the 'Precautionary Principle'. CER (2015) states that if the assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then the precautionary principle should be adopted in the hazard management process. While there is no globally-recognised definition of the Precautionary Principle, it is generally accepted to mean:

> *Uncertain analysis is replaced by conservative assumptions which will increase the likelihood of a risk reduction measure being implemented.*

The degree to which this principle is adopted should be commensurate with the level of uncertainty in the assessment and the level of danger (hazard consequences) believed to be possible.

Under the precautionary principle, environmental considerations are expected to take precedence over economic considerations, meaning that an environmental control measure is more likely to be implemented. In this decision context, the decision could have significant economic consequences to an organisation.

6.6.2 Demonstration of Acceptability

Regulation 13(5)(c) of the OPGGS(E) requires the EP to demonstrate that environmental impacts and risks are acceptable.

NOPSEMA's *Environment Plan decision making* guideline (N-04750-GL1721, June 2021) states that stakeholder consultation plays a large part in establishing the context for defining an acceptable level of environmental impact or risk may be.

Beach considers a range of factors to demonstrate the acceptability of the environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in Table 6-5. The criteria for demonstrating acceptability were developed based on Beach's interpretation of NOPSEMA's *Guidance Note for EP Content Requirements* (N04750-GN1344, Rev 0, February 2014, noting that this has since been superseded) and NOPSEMA's Environment Plan decision making guideline (n-04750-GL1721, June 2021).

Table 6-5: Acceptability criteria

Test	Question	Acceptability demonstrated
Internal context		
Policy compliance	Is the proposed management of the hazard aligned with Beach's Environmental Policy?	The impact or risk must be compliant with the objectives of the company policies.
Management System Compliance	Is the proposed management of the hazard aligned with Beach's OEMS?	Where specific Beach procedures, guidelines, expectations are in place for management of the impact or risk in question, acceptance is demonstrated.
External context		
Stakeholder engagement	Have stakeholders raised any concerns about activity impacts or risks? If so, are measures in place to manage those concerns?	Merits of claims or objections raised by stakeholders must have been adequately assessed and additional controls adopted where appropriate.

Test	Question	Acceptability demonstrated
Legislation, industry standard and best practice		
Legislative context	Do the management controls meet the expectations of existing Commonwealth or state-based legislation?	The proposed management controls align with legislative requirements.
Industry practice	Do the management controls align with international and Australian industry guidelines and practices?	The proposed management controls align with relevant industry guidelines and practices.
Environmental context	What are the overall impacts and risks to MNES and other areas of conservation significance? Are environmental controls aligned to not be inconsistent with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans?	There are no long-term impacts to MNES and the proposed management controls do not conflict with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans.
ESD Principles*	Are the management controls aligned with the principles of ESD?	The EIA presented throughout Chapter 7 is consistent with the principles of ESD.

* See Table 6-6 for further information.

Based on Australia's National Strategy for Ecologically Sustainable Development (Council of Australian Governments, 1992), Section 3A of the EPBC Act 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.*

Table 6-6 outlines the principles of ESD and describes how this EP aligns with these principles.

Table 6-6: Assessment of ESD principles

Principle		EP demonstration
A	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 assessment process.
B	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	Serious or irreversible environmental damage resulting from the activity has been eliminated through the project design (see Chapter 3). None of the residual impacts is rated higher than 'minor' and none of the residual risks is rated higher than 'medium.' Scientific certainty has been maximised by employing a spill EMBA as a risk assessment boundary.
C	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 assessment methodology ensures that risks from the activity are managed to be ALARP and acceptable.
D	The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	This principal is considered for each hazard in the adoption of environmental controls (i.e., environmental performance outcomes and environmental performance standards) that aim to minimise environmental harm.
E	Improved valuation, pricing and incentive mechanisms should be promoted.	This principle is not relevant to this activity.

6.7 Step 7 – Monitor 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 (Chapter 8).

7 Environmental Impact and Risk Assessment

7.1 Overview

This chapter presents the EIA and ERA for the environmental impacts and risks identified for the activity using the methodology described in Chapter 6, as required under Regulations 13(5)(6) of the OPGGS(E).

This chapter also presents the EPO, EPS and measurement criteria required to manage the identified impacts and risks. The following definitions are used in this section, as defined in Regulation 4 of the OPPGS(E):

- **EPO** – a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level (i.e., the environmental objective);
- **EPS** – a statement of the performance required of a control measure; and
- **Measurement criteria** – defines the measure by which environmental performance will be measured to determine whether the EPO has been met.

A summary of the impact consequence rankings and risk ranking for each hazard identified and assessed in this chapter is presented in Table 7-1.

Table 7-1: Activity environmental impacts and risk summary

Identifier	Hazard	Inherent	Residual
Impact		Consequence rating	
1	Seabed disturbance	Minor	Minor
2	Underwater sound – impacts to receptors		
	• Fish (without swim bladders)	Minor	Minor
	• Fish (with swim bladders)	Minor	Minor
	• Low-frequency cetaceans	Moderate	Minor
	• Mid-frequency cetaceans	Minor	Minor
	• High-frequency cetaceans	Minor	Minor
	• Pinnipeds	Minor	Minor
	• Turtles	Minor	Minor
3	Discharge of chemicals	Minor	Minor
4	Light emissions	Minor	Minor
5	Atmospheric emissions	Minor	Minor
6	Putrescible waste discharges	Minor	Minor
7	Sewage and grey water discharges	Minor	Minor
8	Cooling and brine water discharges	Minor	Minor
9	Bilge water and deck drainage discharges	Minor	Minor

Identifier	Hazard	Inherent	Residual
Risk		Risk rating	
1	Displacement of or interference with third party vessels		
	• Displacement	Medium	Low
	• Interference	Medium	Low
2	Accidental discharge of hazardous and non-hazardous materials to the ocean	Medium	Low
3	Vessel collision with megafauna	Medium	Low
4	Introduction and establishment of IMS	Medium	Medium
5	Damage to Subsea Petroleum Infrastructure	Medium	Low
6	MDO release		
	• Benthic fauna	Low	Low
	• Macroalgal communities	Low	Low
	• Plankton	Low	Low
	• Pelagic fish	Low	Low
	• Cetaceans	Low	Low
	• Pinnipeds	Low	Low
	• Marine reptiles	Low	Low
	• Seabirds	Low	Low
	• Shorebirds	Low	Low
	• Commercial fisheries	Low	Low
7	MDO spill response activities		
	• Fauna disturbance	Medium	Low
	• Fauna injury	Medium	Low
	• Fauna death	Low	Low

The following sections assess environmental impacts (arising from planned events, those that do or will happen), and risks (arising from unplanned events, being events that may not happen) as listed in Table 7-1 and presented pictorially in Figure 7-1 and Figure 7-2.

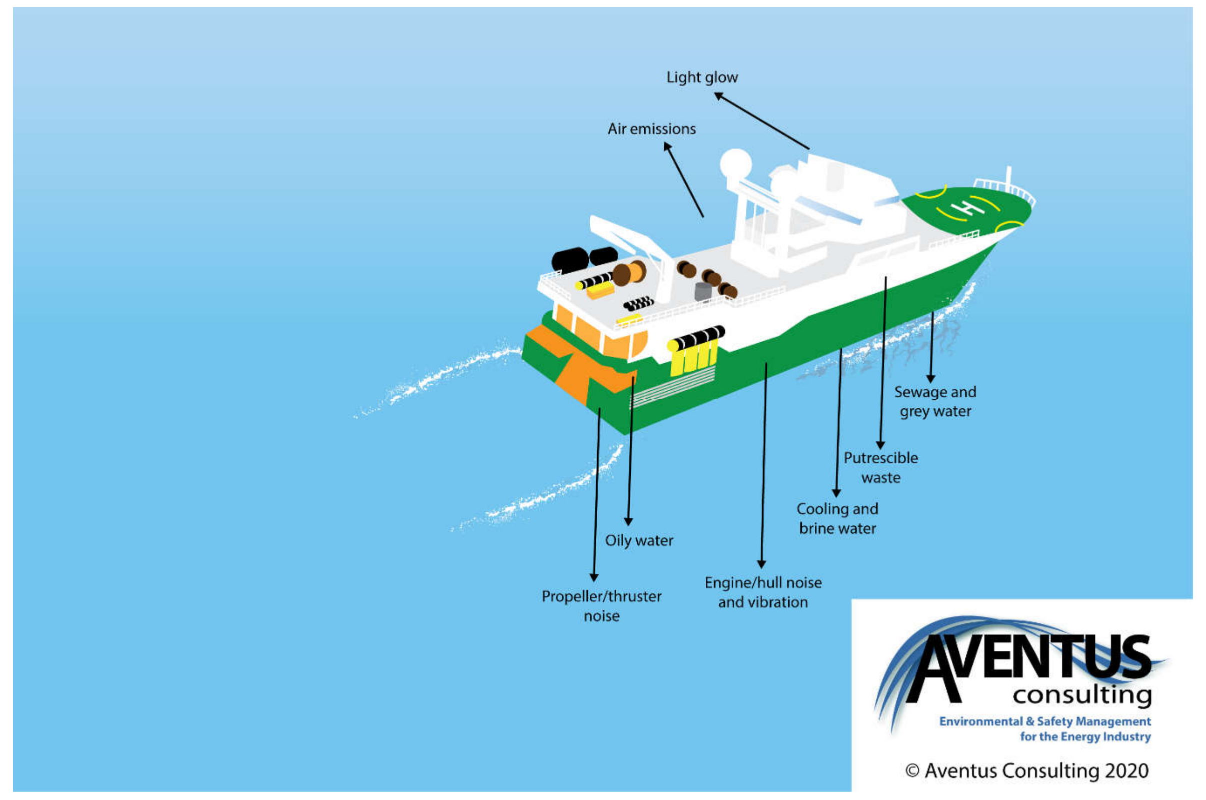


Figure 7-1: Simplified pictorial representation of impacts arising from the activity

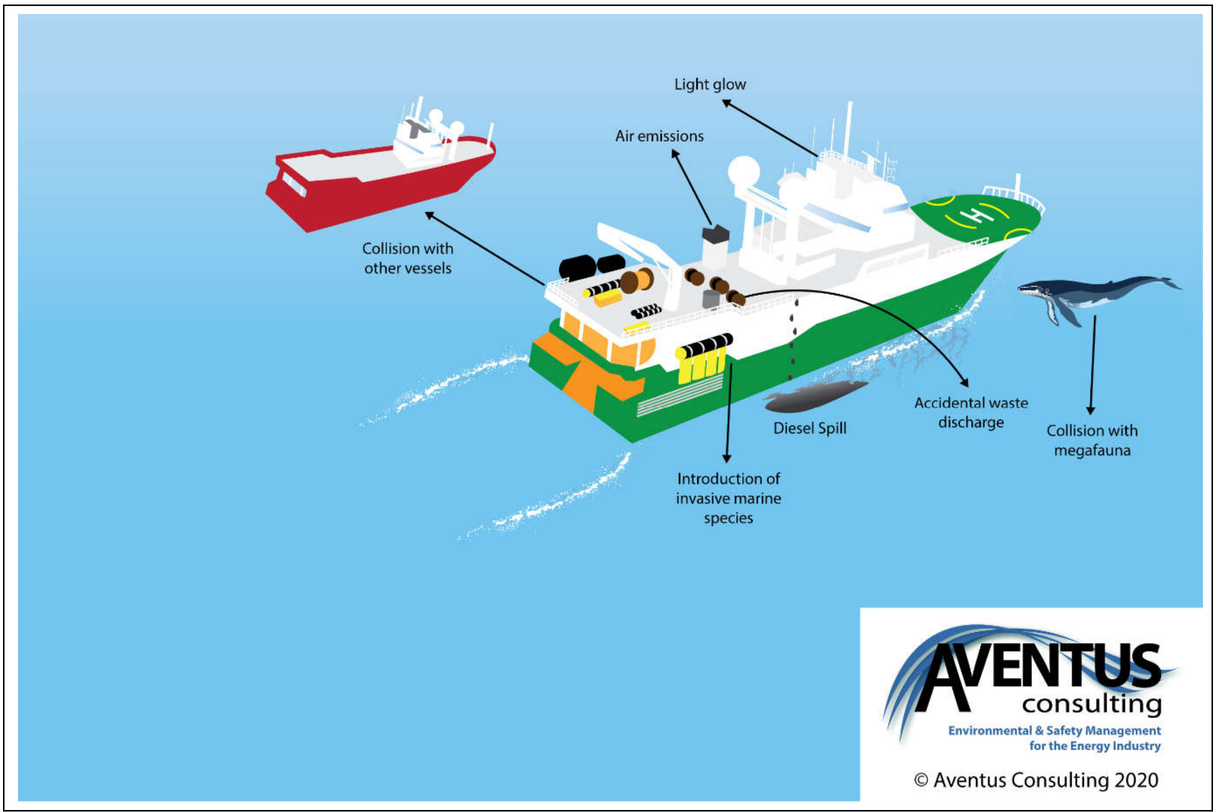


Figure 7-2: Simplified pictorial representation of risks arising from the activity

7.2 IMPACT – Seabed Disturbance

7.2.1 Hazard

The following elements of the activity will result in seabed disturbance:

- Permanent placement of subsea infrastructure on the seabed (e.g., production pools, concrete mattresses, etc). The total footprint is expected to be less than 6,000 m^2 (see Section 3.4);
- Temporary set-down ('wet parking') of equipment on the seabed (e.g. ROV tooling baskets, flying lead deployment frames etc);
- Temporary placement of some subsea infrastructure on the seabed prior to repositioning (e.g., production spools); and
- Sediment displacement (excavation, levelling or water-jetting of seabed sediments to align with infrastructure design criteria).

7.2.2 Known and potential environmental impacts

Seabed disturbance has the potential to impact on marine receptors because of:

- Physical removal or disturbance of seabed sediments;
- Increase in turbidity of the water column near the seabed; and
- Physical injury or death of benthic fauna.

7.2.3 EMBA

The EMBA for seabed disturbance resulting from the installation activities is restricted to tens to hundreds of metres from the installation point. Receptors that are known to occur or may occur within this EMBA are:

- Plankton;
- Benthic species;
- Demersal and pelagic fish species; and
- Marine mammals cetaceans, pinnipeds.

7.2.4 Evaluation of environmental impacts

7.2.4.1 Disturbance of seabed sediments

Physical disturbance of the seabed may cause temporary disturbance to benthic habitats and loss of associated infauna and epifauna. As described in Section 5.4, seabed habitat surveys have been undertaken in the activity area and EMBA. The results of the surveys observed that seabed topography was relatively flat and featureless with no obstructions or features on the seafloor, such as boulders, reef pinnacles or outcropping hard layers in the area likely to be subject to disturbance. The observed habitat supports a diverse infauna dominated by polychaetes, crustaceans and sessile sponges typical of the broader Otway region (Ramboll, 2020; CEE, 2003). Benthic habitats within the activity area comprise soft substrate, typical of deep continental shelf seabed habitats that are widely distributed in the Otway Basin, and commonly found throughout the SEMR (CEE, 2003).

The total disturbance footprint from the subsea installation is expected to be up to 5 km^2, which in the context of the T/L2 and T/L4 permits, and the marine bioregion, occupies a miniscule area of the seabed. The activity may result in the mortality of sessile fauna within this 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 (e.g., ROV), 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.

7.2.4.2 Water column turbidity

Displacement of sediments may occur during subsea equipment deployment and installation, and through sediment excavation, levelling and water-jetting. 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 potential consequence on benthic communities is a localised impact from physical disturbance within the footprint of the activity area, which is expected to be limited given the sparse cover of benthic communities and expected recovery through recolonisation.

7.2.5 Impact Assessment

Table 7-2 presents the impact assessment for seabed disturbance.

Table 7-2: Impact assessment for seabed disturbance

Summary		
Summary of impacts	Removal of and disturbance to seabed sediments. Turbidity of the water column at the seabed. Potential for mortality of benthic infauna and epifauna.	
Extent of impacts	Localised – around individuals points of disturbance.	
Duration of impacts	Temporary – returning to pre-impact condition soon after impact.	
Level of certainty of impacts	HIGH – the impacts of seabed disturbance are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Avoid objects being dropped overboard.	Large bulky items are securely fastened to or stored on the vessel deck/s to prevent loss to sea.	A sea-fastening plan is prepared ahead of mobilisation.
		A completed pre-departure inspection checklist verifies that bulky goods are securely sea-fastened.

	A crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.	Completed handling and transfer procedure checklist, PTWs and/or risk assessments verify that the procedure is implemented prior to each transfer.
	The crane operators are trained to be competent in the handling and transfer procedure to prevent dropped objects.	Training records verify that crane operators are trained in the loading and unloading procedure.
	Visual inspection of lifting gear is undertaken every quarter by a qualified competent person (e.g., maritime officer) and lifting gear is tested regularly in line with the vessel specific PMS.	Inspection of PMS records and Lifting Register verifies that inspections and testing have been conducted to schedule.
	All lifting gear will be supplied with test certifications.	A completed pre-departure inspection checklist verifies that the rigging register is current.
Large objects dropped overboard will be retrieved wherever possible.	An ROV is deployed to search for (and retrieve, where possible), non-buoyant dropped objects so that there is no debris on the seabed at the completion of the activity.	ROV operator logs verify that a post-installation survey took place.
	Dropped objects left behind at the end of construction (that cannot be retrieved) will be reported to NOPSEMA.	Recordable incident report and transmittal to NOPSEMA is available.
Temporary equipment and property is removed from the activity area.	An ROV survey will be undertaken at the completion of the activity to confirm temporary equipment, including any temporarily 'wet parked' dissected Geographe-3 equipment, has been removed from the activity area and the location of subsea infrastructure is recorded. Where the equipment cannot be recovered in this campaign it will be recovered as an activity authorised under the Otway Offshore Environment Plan (see Section 3.7).	ROV survey footage and report verifies that temporary equipment is removed and locations are recorded. Photos of equipment on the vessel deck verify that it has been removed.

Impact Consequence (residual)
Minor
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	• Management system compliance	• Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Relevant persons have not raised concerns about seabed disturbance from vessels during consultation undertaken for the Otway Phase 4 Development.	
Legislative context	The EPS outlined in this EP align with the requirements of: OPGGS Act 2006 (Cth): Section 460(2) – a person carrying on activities in an offshore area under the permit must carry on those activities in a manner that does not interfere with…the conservation of the resources of the sea and seabed.to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.	

Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore marine use (physical disturbance) in Section 4.3.2 of the guidelines: Consider sensitive marine habitats. Reduce footprint.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding seabed disturbance for offshore activities.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	No guidance is provided regarding seabed disturbance.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the impact on benthic communities to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Localised seabed disturbance will not have any impact on AMPs.
	Wetlands of international importance	Localised seabed disturbance does not have any impacts on Ramsar wetlands.
	TECs	Localised seabed disturbance will not have any impacts on TECs.
	NIWs	Localised seabed disturbance will not have any impacts on NIWs.
	Nationally threatened and migratory species	Localised seabed disturbance will not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks	Localised seabed disturbance will not have any impacts on state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Localised seabed disturbance will not compromise the specific objectives or actions of any of the species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
Post-activity ROV survey for dropped objects.

Record Keeping
Equipment pre-deployment inspections. Handling and transfer procedure. Completed handling and transfer checklists. Crane operator qualification and training records. PMS records. PTW records. Load ratings and load test certificates.

ROV survey footage and operator logs.
Incident reports.

7.3 IMPACT – Underwater Noise Emissions

7.3.1 Hazard

The following activities will generate underwater sound:

- Engine noise transmitted through the hull of the CSV;
- Cutting tools (if required) to prepare the production J-tube for connection to the new production spool; and
- Propeller and dynamic positioning noise from the CSV.

7.3.2 Known and potential environmental impacts

In general, the impacts and risks resulting from underwater sound are generally well understood with regard to potential mortality and/or physiological injury for species in the water column, however, uncertainty lies in understanding the spatial and temporal extents of behavioural disturbances and the potential effects on populations and requires the application of context-specific information. The potential environmental impacts to marine fauna from high levels of underwater sound are:

- Physical injury to auditory tissues or other air-filled organs;
- Hearing impairment;
  - Temporary threshold shift (TTS) – the temporary loss of hearing sensitivity caused by excessive noise exposure, or
  - Permanent threshold shift (PTS) – a permanent loss of hearing sensitivity caused by excessive noise exposure, considered an auditory injury.
- Direct behavioural effects through disturbance or displacement, and consequent disruption of natural behaviours or processes (e.g., migration, resting, calving or spawning); and
- Indirect behavioural effects by impairing/masking the ability to navigate, find food or communicate, or by affecting the distribution or abundance of prey species.

Specifically, underwater sound from the CSV has the potential to adversely affect the following environmental values and sensitivities within and in the vicinity of the activity area, to varying degrees:

- Plankton (including commercially important fish larvae/eggs);
- Marine invertebrate assemblages;
- Fish:
  - Mobile pelagic and demersal species that are likely to move away from the vessel as sound levels increase.
  - Site-attached/dependent fish species associated with reef habitats. These species are less likely to move away from the vessel and are expected to seek shelter within reef areas where present.
- Cetaceans:
  - Foraging, migrating and transient whales known to occur in the region (e.g., pygmy blue whales and southern right whales);

- Dolphin species (e.g., bottlenose dolphin, common dolphin).

- Pinnipeds - foraging habitat for the Australian fur-seal and New Zealand fur-seal;
- Foraging habitat for seabirds; and
- Target species for commercially-important fisheries known to operate in the Otway region (e.g., sharks and squid).

7.3.3 EMBA

The EMBA (or maximum distance to effect) for underwater sound from the CSV is based on the results of the modelling of underwater sound levels as per the Technical Memo by JASCO (2022) (Appendix C). The revised study considered numerous modelling scenarios. The most relevant to this activity were for a pipelay vessel operating under dynamic positioning and laying pipe at the TN-1 location (i.e., Scenarios 5 and 6).

Table 7-3 list the distances for behavioural disturbance, and injury from temporary threshold shift (TTS) and permanent threshold shift (PTS) for the fauna groups assessed in the modelling study (Appendix C) based on continuous underwater noise emissions.

Table 7-3: Maximum horizontal distances to noise effect criteria from the sound source (JASCO 2022)

Species in the water column	Behaviour	Injury	
		TTS	PTS
Fish (with swim bladders, involved and not involved in hearing)[1]	*	0.04 km	*
Fish eggs and larvae[1]	Near – moderate Intermediate – moderate Far - low	*	*
Cetaceans – low frequency (LFC)[2]	3.65 km	1.66 km	0.08 km
Cetaceans – mid-frequency (MFC)[2]		0.08 km	0.02 km
Cetaceans – high-frequency (HFC)[2]		1.24 km	0.12 km
Fur-seals (Otariid)[2]		0.02 km	–
Turtles[2,4]	2 km	0.14 km	0.02 km

In accordance with the requirements of the various criteria, only the furthest distance to reach threshold criteria is reported.

1.1.1.1.1. 12 h threshold for TTS and 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al., 2014).

1.1.1.1.2. Behavioural threshold for response to continuous noise (NOAA, 2019).

1.1.1.1.3. TTS and PTS threshold for response to continuous noise (Southall et al. 2019).

1.1.1.1.4. TTS and PTS threshold for marine turtles (Finneran et al., 2016)

- Threshold not reached in the STLM revised modelling study (Appendix C).

** No exposure criterion is available to measure against.*

In summary, the largest spatial extent of impacts is predicted to be:

- Behavioural effect: 3.65 km (for marine mammals).
- TTS: 1.66 km (for low frequency cetaceans).

7.3.4 Evaluation of environmental impacts

7.3.4.1 Fish

Popper et al (2014) reports that there is no direct evidence of mortality or potential mortal injury to fish from ship noise. The 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 noise.

No impacts to fish are expected, as there are not likely to be site-attached fish permanently present in the activity area given the absence of hard substrate. The 48-hr recoverable injury criteria is not predicted to be reached under any scenario. As there are no habitats likely to support site-attached fish in the activity area (i.e., absence of rocky reef), it is also unlikely that fish would be present for a period of 48 hours within the CSV. Thus, recoverable injury impacts are not predicted.

The 12-hr TTS criteria is predicted to be reached within 40 m of the CSV (based on all scenarios). As there are no habitats likely to support site-attached fish in the activity area it is also unlikely that fish species would be present for a period of 12 hours within 40 m of the CSV. Thus, TTS impacts are not predicted.

Behavioural impacts are more likely, such as moving away from the CSV while it is maintaining position on location. There are no habitats or features within the activity area that would restrict fish and sharks from moving away from the CSV.

The activity area is located within a distribution BIA for the white shark, though no habitat critical to the survival of the species or behaviours are identified. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPC, 2013c) does not identify noise as a threat.

The consequence of the CSV being on location for up to 60 days is assessed as 'minor' for fish based on:

- The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPC, 2013c) does not identify noise impacts as a threat.
- Avoidance behaviour may occur within the activity area, however, no habitats likely to support site-attached fish have been identified within the activity area.

7.3.4.2 Turtles

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) 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. Popper et al. (2014) reports that there is no direct evidence of mortality or potential mortal injury to sea turtles from ship noise.

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 (tens 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 2 km of the sound source.

Finneran et al (2017) presented revised thresholds for turtle PTS and TTS for continuous sound, which were applied to the STLM (JASCO 2022). The furthest distance to the PTS criteria for turtles is 20 m and the furthest distance to the TTS criteria is 140 m. These distances do not extend beyond the activity area.

The consequence to turtles from underwater sound generated by the CSV is assessed as 'minor' based on:

- The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat (i.e., nesting beaches). No such turtle habitat is located within the area that may be impacted.
- No BIAs or habitat critical to the survival of turtles occur in Victoria.
- PTS and TTS may occur within 20 m and 140 m. This is a very limited area of impact in an area that lacks important habitat for the species.
- Avoidance behaviour may occur within 2 km of the sound source, noting that no important turtle habitat is located within 2 km of the activity area.
- Low numbers of turtles are predicted in the activity area and therefore impacts would be limited to a small number of individuals (if any) and not at the population level.

7.3.4.3 Marine Mammals

The TTS and PTS exposure criteria are based on cumulative sound exposure levels over a period of 24 hrs. For this assessment the PTS and TTS 24-hr criteria were applied to marine mammals that may be undertaking biologically important behaviours, such as calving, foraging, resting or migration (as defined by the Commonwealth of Australia, 2015b), that could result in them being within the ensonification area above the PTS and TTS criteria for a period of 24 hrs or greater.

Marine mammal behaviours will be influenced by the presence of sound in the environment. The precise change to the behavioural patterns of individual whales is unpredictable so a precautionary approach is required. There are two circumstances where sound exposure needs to be managed differently; when the activity is underway and when the CSV first moves to the activity area.

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus 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. This 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) sound and found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa.

Otariid seals

The furthest distance to the otariid seal (Australian and New Zealand fur-seals and Australian sea lion) PTS criteria is 20 m and the furthest distance to the TTS criteria is 140 m (Table 7-3). The Australian and New Zealand fur-seals may occur within the activity area but no BIAs for these species are identified within the area of ensonification and therefore they are not assessed further.

The distance to the behavioural threshold is 3.65 km. The PMST Report (Appendix B) identified that the Australian and New Zealand fur seal may occur within this area. Impacts are predicted to be temporary avoidance. The consequence is assessed as Minor as there are no biologically important behaviours, BIAs, aggregation areas or haul-out area identified within the predicted ensonified area.

High-frequency cetaceans

The furthest distance to the high-frequency cetaceans PTS criteria is 120 m and the TTS criteria is 1.24 km (Table 7-3). The PMST report for the activity area identified that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the activity area, however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

The distance to the behavioural threshold is 3.65 km. The PMST Report (Appendix B) identified that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within this area. Impacts are predicted to be temporary avoidance. The consequence is assessed as Minor as there are no biologically important behaviours or BIAs identified within the predicted ensonified area.

Mid-frequency cetaceans

The furthest distance to the MFC PTS criteria is 20 m (Table 7-3) and the furthest distance to the TTS criteria is 80 m. The PMST report for the activity area 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 distance to the behavioural threshold is 3.65 km. The PMST Report (Appendix B) identified several dolphin species, beaked and toothed whales that may occur within this area. Impacts are predicted to be temporary avoidance. The consequence is assessed as Minor as there are no biologically important behaviours or BIAs identified within the predicted ensonified area.

Low-frequency cetaceans

The furthest distance to the PTS criteria is 80 m and the furthest distance to the TTS criteria is 1.66 km (Table 7-3). The pygmy blue whale BIAs for distribution and foraging (annual high use area) overlap the activity area (Figure 5-30). The southern right whale BIAs for aggregation, migration and resting on migration, and connecting habitat are over 50 km from the activity area (Figure 5-46). The SRW has been included in this assessment as a conservative measure and for completeness.

The distance to the behavioural threshold is 3.65 km. The PMST Report (Appendix B) identified that blue, southern right, fin, pygmy right and sei whales may occur within this area. Impacts are predicted to be temporary avoidance. The consequence is assessed as Minor for southern right, fin, pygmy right and sei whales as there are no biologically important behaviours or BIAs identified within the predicted ensonified area. The consequence is assessed as pygmy blue whales as the activity area overlaps the BIAs for distribution and foraging (annual high use area).

Foraging behaviour for the blue, fin, pygmy right and sei whales has been identified in the area where the PTS and TTS criteria is reached for LFC. As detailed in Section 5.5.9, cetacean foraging within the Otway shelf, and hence the area where the PTS and TTS criteria is reached, typically peaks from January to April (noting for this activity, the Conservation Management Plan for the Blue Whales (Commonwealth of Australia, 2015b) suggests the whales occur in this region from November to May). This foraging period is within the activity window, therefore it is likely that blue whales will be present in the area at this time of year.

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 5.5.9.2, peak blue whale foraging in the activity 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 the activity will occur. 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 inherent 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.
- 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 5.5.9.2). 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/km^2).
  - 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/km^2). However, they showed mean expected densities of 18.70 blue whales/km^2 and 22.91 blue whales/km^2 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 (60 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 (60 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 (1.66 km) is 8.66 km^2, which represents 0.002% of the pygmy blue whale high density foraging BIA (35,627 km^2). The area within the behavioural distance (3.65 km) is 41.85 km^2, which represents 0.117% of the BIA.
- Adopted controls as detailed in Section 7.3.5 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 5.3.10.2). 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 Section 7.3.5 means that blue whale displacement from a foraging area is unlikely to 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 7-4 for an assessment of the activity with the conservation objectives and actions of the Conservation Management Plan for the Blue Whale.

Table 7-4: Assessment of underwater noise against 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 7-6 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 7-6 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 7-6 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 aim / objective / action	Assessment
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 7-6 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.
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.	
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 7-6 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

The Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012a) identifies shipping and industrial noise as a threat that is classed as a 'minor' consequence, which is defined as individuals are affected but no affect at a population level. The conservation plan states that given the behavioural impacts of noise on SRW are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

SRW move through the area during May-June and September-November. The activity timing (between 1st December 2022 and 31st May 2023) partially overlaps with the timing when SRW move towards coastal aggregation and migration areas. The closest distance to a SRW BIA (migration and resting on migration) is over 50 km northeast from the ensonified area (Figure 5-46). As this is outside of the ensonified area for behavioural effects (3.65 km), behavioural impacts to SRW in this BIA are not predicted.

An emerging aggregation area has been identified at Port Campbell, which has not been spatially defined. The Conservation Management Plan for the Southern Right Whale (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 over 50 km north from the area of potential occupancy for the Port Campbell emerging aggregation area (Figure 5-46). 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 are not predicted.

Given that the closest distance to the identified areas of SRW biologically important behaviours (such as, resting or migration) is over 50 km from the activity area, TTS and PTS are not assessed for these areas as impacts are not predicted beyond 1.66 km of the sound source. Regarding its core coastal range, the area of impact is small with the distance to TTS criteria being 1.66 km. At any one time the largest area of impact would be 8.66 km^2, which equates to 0.004% of the SRW core coastal range BIA (217,825 km^2).

The ensonified area for marine mammal behavioural response is located within the SRW core coastal range. As detailed in Section 5.5.9.10 there is the potential for SRW to be transiting through the noise behaviour 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. The activity timing partially overlaps with the latter of these periods. The Conservation Management Plan for the Southern Right Whale (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 3.65 km equates to an area of 41.6 km^2, which is approximately 0.02% of the SRW core coastal range (217,825 km^2). 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.

The inherent severity of potential impact from the activity is assessed as minor, and of an acceptable level because:

- The Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012a) details that shipping and industrial noise are classed as a 'minor' consequence.
- Though the activity will be undertaken during the period when SRW may be travelling through the ensonified area to coastal aggregation and migration areas, the area of potential impact is small (0.02 % of its core coastal range) and does not constitute an impediment to SRW approach to these coastal areas.
- The ensonified area above the marine mammal behavioural response threshold does not intersect any established or emerging aggregation areas nor any calving/breeding areas (Figure 5-46).
- Low numbers of SRW are predicted in and around the activity area based on aerial surveys 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, as the whales prefer to occupy depths of less than 10 m (see Section 5.5.9.10).
- SRW may avoid the ensonified area above the marine mammal behavioural response threshold but there is no impediment to them continuing to the coastal aggregation and migration areas. SRW are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (DSEWPC, 2012a). Along the Australian coast, individual SRW 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 (DSEWPC, 2012a). As such, avoidance of the ensonified area is unlikely to prevent or hinder them from undertaking their seasonal migrations.
- Low numbers of SRW are predicted within the ensonified area based on aerial surveys in the Otway region (2002 – 2013) that 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 preference. 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 7.12 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 (see Figure 5.23). The activity will be managed in a manner that is not inconsistent with this conservation objective of the Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012a). See Table 7-5 for an assessment of the activity with the conservation objectives and actions of the Conservation Management Plan for the Southern Right Whale.

Table 7-5: Assessment of underwater noise against the Conservation Management Plan for the Southern Right Whale

Relevant aim/objective/action	**Assessment**
Relevant Interim Recovery Objectives and Targets	
Interim Recovery Objective 2: Demonstrate that the number of SRW occurring off south-east Australia (nominally the south-east Australia population) is showing signs of increase.	

Relevant aim/objective/action	Assessment
Target 2.2: the number of whales off south-east Australia shows an apparent increase for the period 2011–2021 relative to 2005–2010: 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.	The EIA and EPS listed in this EP (Table 7-6) demonstrates that anthropogenic threats are minimised and reduced wherever possible. The activity location is located 50 km distant from the SRW emerging aggregation area at Port Campbell (Figure 5-46) and has been assessed not to constitute a permanent impediment to SRW travelling through the esonofied area to coastal and migration areas.
Interim Recovery Objective 5: Anthropogenic threats are demonstrably minimised.	The EIA and EPS listed in this EP (Table 7-6) 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.
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.	The EIA and EPS listed in this EP (Table 7-6) has been designed to avoid mortality of SRW.
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.	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 has been considered in this EP.
Relevant Action Area and Actions	
Action Area A.2. Assessing and addressing anthropogenic noise.	
Action: Improve the understanding of what impact anthropogenic noise may have on southern right whale populations by: a) Assessing anthropogenic noise in key calving areas b) Assessing responses of southern right whales to anthropogenic noise c) If necessary, developing further mitigation measures for noise impacts.	Key calving areas have been assessed with regard to anthropogenic noise generated by the activity (Figure 5-46). The nearest calving area located near Warrnambool is approximately 85 km from the centre of the activity area. The EIA has assessed responses of SRW to anthropogenic noise. As per the EPS listed in Table 7-6, MMOs will be onboard the CSV throughout the activity duration (noting the activity may occur any time within the activity window) as a mitigation measure for noise impacts.
Assess and address anthropogenic noise (shipping, industrial and seismic).	The EIA in this EP is consistent with this conservation objective.

Fin, pygmy right and sei whales

Fin whales have been sighted inshore in the proximity of the Bonney coast upwelling, Victoria, along the continental shelf in summer and autumn months (DAWE, 2022b). Sei whales have been sighted between November-May (upwelling season) during aerial surveys conducted between 2002-2013 in South Australia (Gill *et al.*, 2015). Sei whale feeding was observed during these aerial surveys, which is one of the first documented records of sei whale feeding in Australian waters, suggesting that the region may be used for opportunistic feeding (Gill *et al*., 2015). There is limited information on pygmy right whales, with their area of occupancy not able to be calculated due to the paucity of records for pelagic waters off Australia and the subantarctic (DAWE, 2022b). Aerial surveys undertaken over western Bass Strait and the eastern Great Australian Bight between 2002 and 2013 recorded one sighting of 100+ pygmy right whales just southwest of Portland in June 2007 (Gill *et al*., 2015). Based on the information available for fin, pygmy blue and sei whales, foraging within the Otway area is linked to the Bonney Coast Upwelling KEF. Opportunistic foraging may occur within this area, however, the area of disturbance is small in an area where there are no BIAs or known areas of occupancy for these species.

The fin, pygmy right and sei whales do not have conservation management plans. The sei and fin whales have conservation advice (TSSC, 2015c; TSSC, 2015d) that both identify anthropogenic noise as a threat with the conservation and management actions of:

- Once the spatial and temporal distribution (including BIAs) 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 sei and fin whales' conservation advice (TSSC, 2015c; TSSC, 2016d) has a consequence rating for anthropogenic noise and acoustic disturbance as 'minor' with the extent over which the threat may operate as 'moderate' to 'large'. There is no conservation advice for the pygmy right whale and the SPRAT database does not identify anthropogenic noise and acoustic disturbance as a threat (DAWE, 2020b).

The impacts to fin, pygmy right and sei whales are assessed as 'minor' and are of an acceptable level based on:

- The sei and fin whale's conservation advice (TSSC, 2015c; TSSC, 2016d) has a consequence rating for anthropogenic noise and acoustic disturbance as 'minor', with the extent over which the threat may operate as 'moderate' to 'large'.
- The pygmy right whale SPRAT database (DAWE, 2022b) (in lieu of no conservation advice) does not identify anthropogenic noise or acoustic disturbance as a threat.
- Low numbers of fin, sei and pygmy right whales are predicted within the activity area based on the following:

    No BIAs are identified for these species.

    The TTS ensonification area is over 80 km southeast from the Bonney Coast Upwelling KEF, which is known as a feeding aggregation area (Gill *et al*., 2011; McCauley *et al*., 2018).

    The TTS ensonification area is located within an area with a historical frequency of <10% of an upwelling occurring (Huang and Wang, 2019).

    The behaviour threshold is approximately 80 km from the Bonney Upwelling Coast KEF, which is a known feeding aggregation area (Gill *et al*., 2011; McCauley *et al*., 2018) and based on the occurrence of an upwelling event between 2002 and 2016 has an upwelling frequency of 30 – 50% which is classed as seasonal (Huang and Wang, 2019). The behaviour threshold is within an area with a historical frequency of <10% of an upwelling occurring (Huang and Wang, 2019).

    Aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of eight 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.

Fin, sei and pygmy right whales are not residents in the area. As detailed for pygmy blue whales, they migrate through the Bonney Coast Upwelling KEF and adjacent waters based on where krill aggregations occur.

- Low numbers of fin, sei and pygmy right whales are predicted within the ensonified area for marine mammal behavioural response based on the following:
- There are no habitats critical to the survival of marine mammals (other than pygmy blue whales) within the ensonified area for behavioural responses.

7.3.5 Impact Assessment

Table 7-6 presents the impact assessment for the generation of underwater sound.

Table 7-6: Impact assessment for underwater sound

Summary			
Summary of impacts	Physiological or pathological impacts to local populations of marine fauna.		
Extent of impacts	Up to 3.65 km		
Duration of impacts	Underwater sound will only be generated for the duration of the activity.		
Level of certainty of impacts	Moderate – for turtles and seals High – for fish and cetaceans.		
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined. Vessel activities are regularly undertaken and have a mature regulatory framework in Australia.		
Impact Consequence (inherent)			
Receptor	Consequence rating		
Fish – with swim bladders	Minor		
Fish – without swim bladders	Minor		
LFC	Moderate		
MFC	Minor		
HFC	Minor		
Pinnipeds	Minor		
Turtles	Minor		
Assessment of Proposed Control Measures			
Control measure	Control type	Adopted	Justification
Conduct the activity outside of the peak blue whale foraging and migration period (January to March inclusive for the activity area)	Eliminate	No	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. 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. 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 dollars) associated with this control measure is not commensurate with the low residual consequence rating for cetaceans.
Anchoring of the CSV during installation activities	Substitution	No	Vessel noise could be minimised by the CSV anchoring while on location. 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. However, in the event of a whale-instigated shutdown, the vessel would shut down the DP where safe to do so and move to a safe anchoring location away from subsea infrastructure.
DP shutdown zones for the vessel	Engineering	Yes	Implemented with safety controls. Shutdown zones will be implemented in accordance with the Whale Management Procedure (Section 8.11.1.1)
Use of passive acoustic monitoring (PAM) for the detection of cetaceans.	Engineering	No	PAM was considered as an alternate means of detecting the presence of cetaceans during the activity. As a cetacean detection method, PAM has been used to detect whales that vocalise at high frequencies/intensities such as MFC and HFC (e.g., sperm whales) and, in conjunction with visual monitoring, can enhance cetacean detection effectiveness. PAM has the advantage of potentially detecting cetaceans during night hours and during periods of poor visibility when they cannot be visually detected. Although PAM can be a valuable tool in identifying the presence of cetaceans, the following factors limit its effectiveness: Most suitable for MFC and HFC, which are generally of lower concern in this region compared to LFC. It is difficult for PAM to pick up vocalisations of LFC such as blue whales and southern right whales. Bearing accuracy and range estimation is limited because it is not as accurate as visual observations. The use of an experienced MMO negates the need for using PAM given that LFC (which surface to breath more regularly that deeper-water MFC and HFC) will generally be able to be easily detected.
Use of a competent Marine Mammal Observer (MMO) for each working shift during daylight hours for the duration of the activity.	Administrative	Yes	Two MMOs will be onboard the CSV at all times, with at least one MMO on shift during daylight hours so that a trained expert is dedicated to search for whales and implement the whale management procedure. 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 are being contracted through a reputable consultancy that trains and provides MMOs on a range of projects around Australia. Vessel crew who act as Office of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO on shift during daylight hours. The benefits of having two MMOs onboard the CSV rather than one outweighs the costs of implementation.
Pre-start survey of the observation zone (3.65 km	Administrative	Yes	The sound modelling undertaken predicts behavioural impacts to LFC to 3.65 km from the CSV. In order to not injure or displace whales that may be present in this zone prior to operations

radius) for whales during daylight hours prior to the CSV beginning operations in the activity area.			commencing, a pre-start survey of the observation zone will be undertaken in daylight hours prior to the CSV beginning operations in the activity area. This will ensure that no foraging or migrating whales will be exposed to injury (e.g., PTS or TTS) or be displaced when the CSV begins operations. Observations will be in accordance with Beach's Whale Management Procedure (Document number CDN/ID S4130AF725242) and NOPSEMA conditions for the Otway Phase 5 Early Dive EP (see Section 2.1.3).
CSV to shut down if whales are observed within the observation zone during operations.	Administrative	Yes	Shutdown zones will be in accordance with Beach's Whale Management Procedure (Document number CDN/ID S4130AF725242) and NOPSEMA conditions for the Otway Phase 5 Early Dive EP (see Section 2.1.3).
Implement night-time and low visibility whale procedures	Administrative	Yes	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 (3.65 km radius) in the 3 hours prior to sunset (using sunset times provided the Bureau of Meteorology).
Monitoring upwelling events pre-mobilisation – sea surface temperature and chlorophyll-a	Administrative	No	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.
Satellite imagery	Administrative	No	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 recent 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: 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 to analyse the images. This delay makes satellite imagery unsuitable for making a decision to mobilise or to begin operations. 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. Given these factors, this technology is unreliable for the purpose of whale behaviour identification, thus no environmental benefit is achievable regardless of the cost.
Drone surveys	Administrative	No	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: 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. 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.
Infra-red systems	Administrative	No	Infra-red (IR) systems could enhance the ability of MMOs to visually detect the presence of foraging or potentially foraging whales. Infra-red systems are not available as a real-time monitoring tool for operations and have the following limitations: 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; Smith *et al*., 2020). 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. 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.
Dedicated MMO monitoring vessel	Administrative	No	An additional dedicated MMO vessel is not considered to represent an ALARP solution as monitoring activities can effectively be carried out by an MMO situated on the CSV. 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.
Undertake aerial observations for whales prior to and during the activity.	Administrative	No	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: 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. 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. 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 minor' residual impact consequence for cetaceans. Aerial flights will be undertaken as part of the Otway Offshore Drilling Campaign. If the activity commences in November or during the blue whale peak foraging period, then flights will take place over the activity area as part of the planned observations.

		Information from these flights will be provided to the MMO onboard the CSV.
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
CSV engines and DP thrusters are well maintained.	Engines and DP thrusters are maintained in accordance with manufacturer's instructions via the Planned Maintenance System (PMS) to ensure they are operating efficiently.	PMS records verify that engines and DP thrusters are maintained to schedule.
There is no cetacean injury (PTS and TTS) and no displacement from foraging, aggregating, calving/breeding or migrating in BIAs and emerging aggregation areas.	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. 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). 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.	MMO CVs verify they are competent in undertaking MMO duties. MMO sighting data from the CSV vessel is available for the duration of the activity. MMO daily reports.
	Whale Management Procedure (Document number CDN/ID S4130AF725242): Prior to an activity commencing an observation survey will be undertaken of the observation survey zone for the activity (3.65 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. For activities undertaken between 1 December 2022 and 30 April 2023 the shutdown zone is 3.65 km for blue whales and southern right whales. For all other times and for all other species the shutdown zone is 1.66 km. On advice from the MMO that a whale has been 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 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. 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 (3.65 km radius) in the 3 hours prior to sunset (using sunset times provided the Bureau of Meteorology).	MMO daily reports. Daily operations reports. JASCO (2022) report identifying: - 3.65 km behavioural threshold - 1.66 km TTS threshold

	This whale management procedure is included as a flowchart in Section 8.11.1.1.	
	Helicopters will not fly lower than 1,650 ft when within 500 m horizontal distance of a cetacean except when landing or taking off and will not approach a cetacean from head on.	MMO daily report.
	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.
	As part of the activity induction all vessel crew will be inducted into cetacean management and the importance of reporting whale sightings to the MMOs immediately.	Induction presentation and sign-on sheet.
	Vessel crew who act as Officer of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO on shift during daylight hours.	Demonstration of compliance will be training records.
Cetacean sightings are reported to government.	Beach will report cetacean sightings online to the DCCEEW within 2 months of survey completion using the online Cetacean Sightings Application: http://www.marinemammals.gov.au/sorp/sightings	Copies of sighting reports are maintained to verify reports were made.

Impact Consequence (residual)	
Receptor	Consequence rating
Fish – with swim bladders	Minor
Fish – without swim bladders	Minor
LFC	Minor
MFC	Minor
HFC	Minor
Pinnipeds	Minor
Turtles	Minor

Demonstration of ALARP

'Minor' residual impact consequences are considered to be ALARP and a 'lower order' impact. The following ALARP analysis provides additional assurance that all risk treatment options have been considered. Control measures that have been considered to reduce the impacts of underwater sound on biological receptors, but not adopted, are outlined below.

Demonstration of Acceptability

Defined acceptable level	Underwater sound from the activity does not result in disturbance such as injury or displacement from foraging, aggregation, calving/breeding areas or migration routes for EPBC Act-listed threatened and migratory cetaceans. Acceptable levels of noise impact for SRW and blue whales are defined as: • No disturbance (including stress response impact) to calving whales, including SRW at the emerging aggregation area at Port Campbell. • No disturbance to SRW migration pathway and movements in and out of the emerging aggregation area at Port Campbell. • No displacement from the blue whale foraging BIA and migration pathway.

Statement of acceptability	Marine fauna is not injured or displaced from foraging, breeding and nesting grounds or migratory routes. The activity is not inconsistent with the aims of relevant conservation management plans identified in Section 7.3.4.	
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	OEMS compliance	Chapter 8 describes the EP implementation strategy employed for this activity. It is demonstrated that all the standards in the OEMS have been met during the planning phase of this activity and can be met during the implementation phase of this activity.
External context	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. **Relevance to marine fauna** There has been no concern expressed by stakeholders or relevant persons about impacts to marine fauna from underwater sound associated with this activity.	
Legislative context	The EPS developed to avoid, minimise or mitigate for the impacts of underwater sound to marine fauna align with the requirements of: *EPBC Act* 1999 (Cth). Section 254 – all listed marine species are protected in Australian waters, and it is an offence to kill or injure a listed marine species without a permit. *OPGGS Act* 2006 (Cth). Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation, fishing, conservation of the resources of the sea and seabed (and other matters) to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the person.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice (listed in order of most to least recent) demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity take into account the management measures listed for construction in Section 4.4.1 of the guidelines, which include: Considering sensitive locations and times of year for critical activities of species that are present. Using MMOs.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding underwater noise for offshore activities.
	Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities (Prideaux, 2017)	• This document was developed to present the BPEM for marine noise-generating activities. It includes 12 modules covering various species groups and what should be taken into consideration when undertaking EIA. • Multiple sections are relevant to this EP including Section B4, B5, B10 and B11. These sections discuss EIA assessment criteria, which have been considered in this EP (i.e., assessment against TTS, PTS and behavioural thresholds).
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS developed for this activity meet the requirements of these guidelines with regard to: Noise (item 74) – the preparation of this EP meets the objectives of these guidelines because sensitive areas for marine life are identified.
	APPEA CoEP (2008)	The EPS developed for this activity meet the requirements of this guideline with regard to development and production objectives:

		To reduce the impact on cetaceans and other marine life to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	The nearest AMP (Apollo) is outside the furthest distance to behavioural impacts (3.65 km). As such, impacts to the conservation values of the AMP are not expected.
	Ramsar wetlands	The STLM indicates sound created by the activity will not reach levels that will impact the conservation values and sensitivities of the nearest Ramsar wetland.
	TECs	The STLM indicates sound created by the activity will not reach levels that will impact the conservation values and sensitivities of the nearest TEC.
	KEFs	The STLM indicates sound created by the activity will not reach levels that will impact the conservation values and sensitivities of the nearest KEF.
	NIWs	The STLM indicates sound created by the activity will not reach levels that will impact the conservation values and sensitivities of the nearest NIW.
	Nationally threatened and migratory species	**Cetaceans:** The activity will not have a 'significant' impact on threatened cetacean species when assessed against the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013b). The Conservation Advice documents and Recovery Plans for each of the threatened cetacean species lists anthropogenic noise and acoustic disturbance as a threat, with those for the sei and fin whales assigning this a consequence rating of 'minor.' Cetaceans are omnipresent throughout the South-east Marine Bioregion. There is no limiting habitat restricting these species to migrating, foraging, breeding or resting specifically within the proposed activity area or area of ensonification. Displacement from foraging areas is not predicted based on the control measures in place. **Fish:** The activity will not have a 'significant' impact on threatened fish species, when assessed against the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013b). **Pinnipeds:** Pinnipeds are listed marine species and not threatened or migratory. **Turtles:** turtles are listed migratory and threatened species. This EIA addresses potential impacts of the activity to turtles.
	Other matters	
	State marine parks	The STLM indicates sound created by the activity will not reach levels that will impact the conservation values and sensitivities of the nearest state marine park.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The following management plans and species conservation advice are relevant to the activity: The Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013c) Conservation Management Plan for the Blue Whale (DoE, 2015d). Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a).

		Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015c). Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015d). The EPS listed in this table are designed to avoid or reduce to ALARP and an acceptable level the threats regarding noise interference listed in these plans. The activity will be managed in a manner that is not inconsistent with the management aims and actions of the plans.
ESD principles	The application of the ESD principles to marine fauna are outlined here.	
	A. Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	The STLM undertaken to support the EIA indicates that there are unlikely to be short-term or long-term impacts to marine fauna.
	B. If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The STLM indicates that PTS impacts are only likely within very close proximity to the vessel over long periods of time, with TTS possible over slightly longer distances. PTS and TTS are unlikely to occur due to the implementation of the control measures in this EP. Behavioural impacts, which extend up to 3.65 km for LFC from the CSV, will not lead to serious or irreversible damage to marine fauna.
	C. The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Impacts to marine fauna are assessed to be localised and temporary. The impacts will not affect present and future generations in terms of maintaining biodiversity for its intrinsic value.
	D. The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	Impacts to marine fauna are assessed to be localised and temporary. There will not be a loss of species diversity and abundance as a result of the activity.
	E. Improved valuation, pricing and incentive mechanisms should be promoted.	Not relevant.
Comparison with defined acceptable level of impact	The impacts of this hazard are acceptable because the evaluation of impacts predicts there will be no injury or displacement from foraging, aggregation, calving/breeding areas or migration routes for EPBC Act-listed threatened and migratory cetaceans.	

Environmental Monitoring
MMO observations from the CSV (and/or support vessel) throughout the activity duration.

Record Keeping	
CSV PMS records Cetacean sightings.	Vessel crew induction presentation and sign-on sheets. Training records (Office of the Watch).

MMO CVs. MMO daily reports.	Daily operations reports.

7.4 IMPACT – Discharge of Chemicals

7.4.1 Hazard

The following activities have the potential to result in chemicals being discharged to the ocean:

- As spools are lowered from sea surface to seabed, a maximum of 4 m^3 of inhibited water and MEG may be discharged as the spool bores are open;
- During commissioning, approximately 8 m^3 of inhibited potable water and MEG may be discharged as spools are flushed pre or post hydrotest;
- A maximum of 4 m^3 of grout may be released during the grouting operation; and
- During HFL function testing, there is a low possibility that up to 500 L of hydraulic fluid may be released.

7.4.2 Known and potential environmental impacts

The known and potential environmental impacts of these discharges are:

- Temporary and localised decrease in water quality in the immediate vicinity of the discharge location; and
- Potential toxicity impacts to marine fauna from the ingestion of discharged chemicals.

7.4.3 EMBA

The EMBA for the discharge of subsea chemicals and hydraulic fluids is likely to be tens of metres from the discharge location (in the down current direction), based on the fact that currents will rapidly dilute low volume discharges.

7.4.4 Evaluation of Environmental Impacts

All chemicals have been selected using Beach's Chemical Plan (Section 8.11.1.2).

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 is a water-based fluid that is ranked "D" in the OCNS ranking. Class-G cement is rated as PLONOR and 'E' (non-CHARM).

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;
- Temporary nature of the discharges;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the activity area.

7.4.5 Impact Assessment

Table 7-7 presents the impact assessment for discharge of chemicals.

Table 7-7: Impact assessment for discharge of chemicals

Summary		
Summary of impacts	Temporary and localised decrease in water quality and potential toxicity impacts to marine fauna from ingestions of discharged chemicals.	
Extent of impacts	Localised – within tens of metres of the release.	
Duration of impacts	Temporary – returning to pre-impact condition soon after discharge.	
Level of certainty of impacts	HIGH – the impacts of chemical discharges are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Only low toxicity, readily biodegradable and non-bioaccumulating chemicals will be discharged to minimise ecotoxicity impacts to marine fauna.	Only PLONOR, 'D'/'E' (nonCHARM) or 'Gold'/'Silver' (CHARM) OCNS-rated chemicals and additives are discharged.	The chemical inventory verifies that all chemicals to be discharged during the commissioning program are PLONOR, 'D'/'E' (non-CHARM) or 'Gold'/'Silver' (CHARM) OCNS-rated.
	Where for technical reasons a chemical is required that has not been registered with CEFAS (and therefore does not have a rating), the CHARM, or in the case of non-CHARMable products, the OCNS process (https://www.cefas. co.uk/cefas-data-hub/offshorechemicalnotification-scheme/ hazardassessment-process/) will be applied to calculate the CHARM rating or OCNS grouping. Only additives with a hazard quotient of <30 (silver/gold ranking) or an OCNS grouping of D/E will be used.	MoC documentation verifies that, for products not registered with CEFAS, the CHARM and/or OCNS process has been applied and that only additives with a hazard quotient of <30 or an OCNS grouping of D/E are used.
Prevent loss of cement to the seabed while filling grout bags.	The pumping of grout bags will be monitored via ROV to ensure that pumping stops as soon as cement overflow is observed.	ROV report.
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.

	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Relevant persons have not raised concerns about chemical discharges during consultation.	
Legislative context	The EPS outlined in this EP align with the requirements of: OPGGS Act 2006 (Cth): Section 460(2) – a person carrying on activities in an offshore area under the permit must carry on those activities in a manner that does not interfere with…the conservation of the resources of the sea and seabed to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore marine use in Section 4.5.4 of the guidelines: Chemicals additives are selected for environmental performance.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding discharge of chemicals for offshore activities.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	No guidance is provided regarding discharge of chemicals for offshore activities.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the impact on benthic communities to ALARP and to an acceptable level. To reduce the volume of wastes produced to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	Localised chemical discharge will not have any impact on AMPs.
	Wetlands of international importance	Localised chemical discharge does not have any impacts on Ramsar wetlands.
	TECs	Localised chemical discharge will not have any impacts on TECs.
	NIWs	Localised chemical discharge will not have any impacts on NIWs.
	Nationally threatened and migratory species	Localised chemical discharge will not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks)	Localised chemical discharge will not have any impacts on state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Localised chemical discharge will not compromise the specific objectives or actions of any of the species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP.

ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).
Environmental Monitoring	
ROV monitoring during filling of grout bags.	
Record Keeping	
Chemical inventory. MoC documents.	

7.5 IMPACT – Light emissions

7.5.1 Hazards

During the activity 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 emissions from the vessels will result in a change in ambient light.

7.5.2 Known and potential environmental impacts

The known and potential impacts of lighting are:

- Light glow may act as an attractant to light-sensitive species (e.g., seabirds, squid, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).
- Potential collision, entrapment, stranding and grounding on offshore infrastructure and disorientation or interference with navigation from usual migration routes (Pendoley Environmental, 2021).

Beach commissioned Pendoley Environmental to undertake a Seabird Light Management Plan for its Otway Offshore operations. This management plan was developed in accordance with National Light Pollution Guidelines for Wildlife (DoEE, 2020). Potential impacts of lighting on seabirds and shorebirds are addressed in the Seabird Light Management Plan: Otway Development Drilling and Well Abandonment (Rev 0, 2021).

7.5.3 EMBA

Light-sensitive receptors are identified in the National Light Pollution Guidelines for Wildlife (DoEE, 2020). These guidelines identify marine turtles, seabirds and shorebirds as having the potential to be impacted by artificial light to a level that may require an EIA. Although addressed in the guidelines, fish have not been identified as being light-sensitive enough to require further assessment. The aim of the guidelines is to ensure that artificial light is managed so wildlife is:

- Not disrupted within, nor displaced from, important habitat; and
- Able to undertake critical behaviours such as foraging, reproduction and dispersal.

The guidelines recommend undertaking a light impact assessment where important biologically important habitats (i.e., BIAs) are necessary for an ecologically significant proportion of a listed species to undertake foraging, breeding, roosting or migrating. The 20 km distance applied by the guidelines provides a precautionary limit based on observed effects of sky glow on fledgling seabirds grounded in response to artificial light from 15 km away (DoEE, 2020).

Therefore, a conservative distance of 20 km radius from the centre of the activity area (see Section 3.1) is used for the light assessment, and is referred to as the 'light EMBA' (see

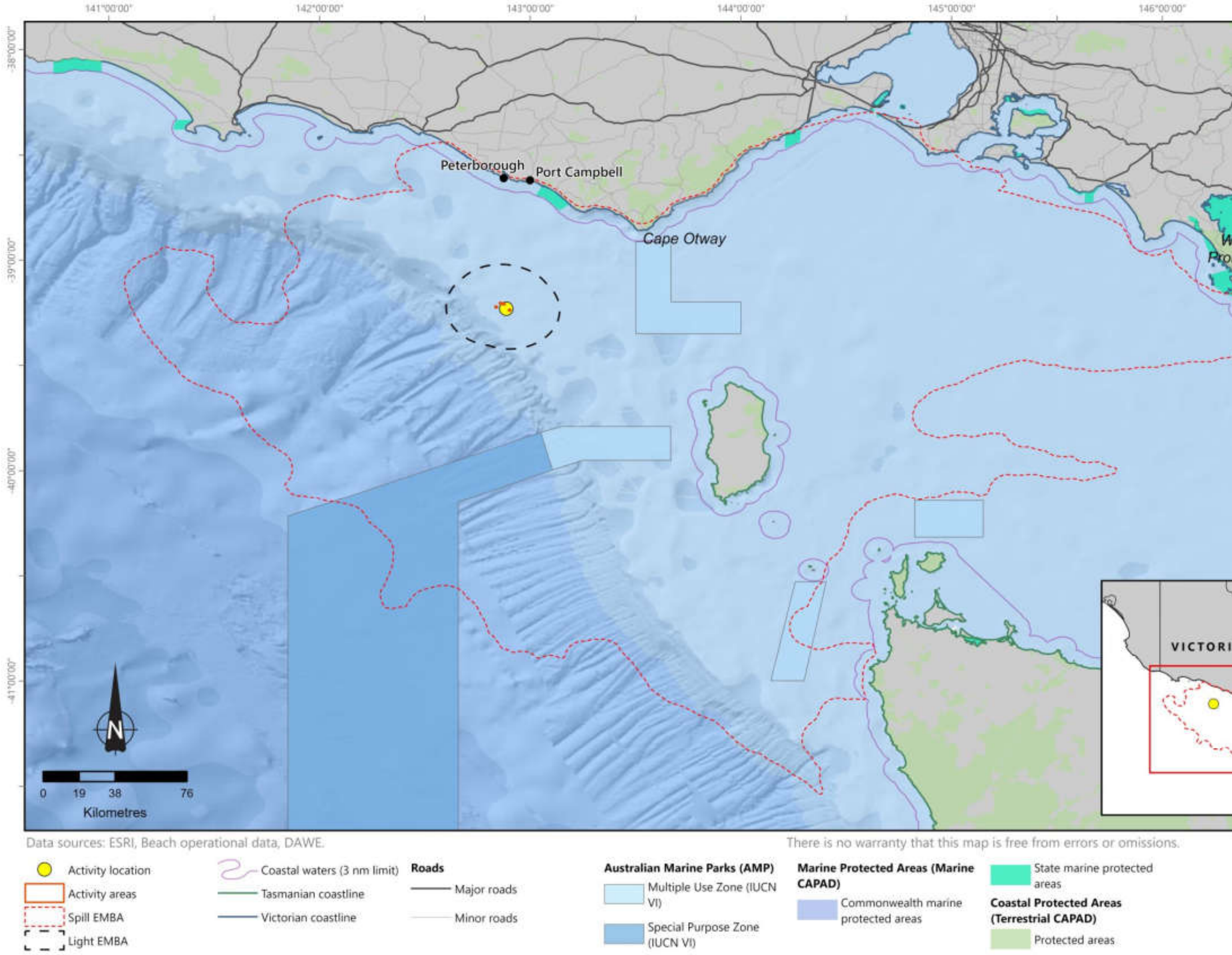


Figure 7-3). It is noted that only a single 20 km light EMBA will occur at any one time from within the activity area, the primary source of artificial light being the CSV.

Light-sensitive receptors that may occur within the light EMBA, either as residents or migrants, are:

- Plankton;
- Fish (e.g., squid);
- Turtles; and
- Seabirds and shorebirds.

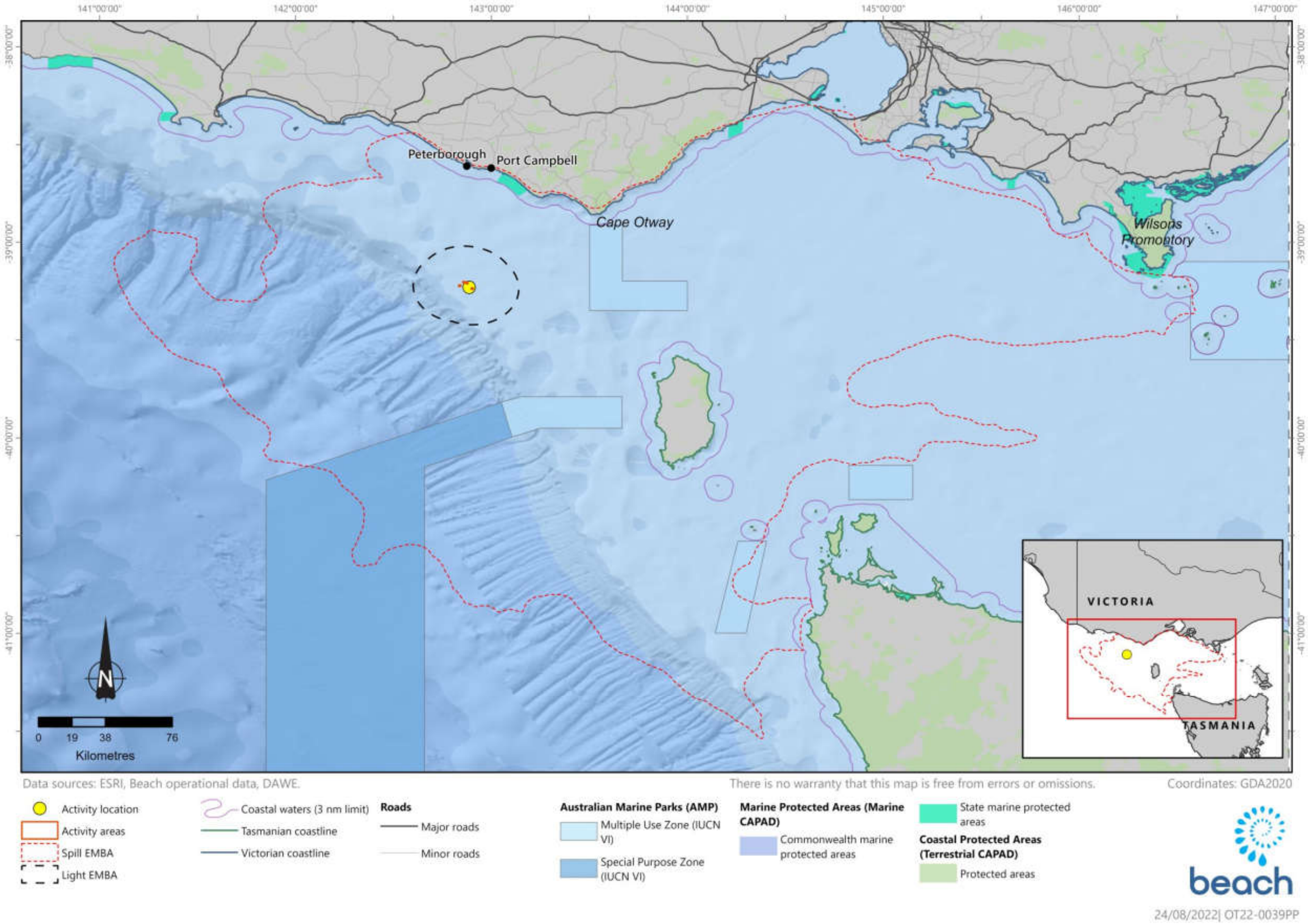


Figure 7-3: The light EMBA

Table 5-5 lists the BIAs for species which may occur in the light EMBA (NB: same species as identified in the activity area). These have been identified from the light EMBA PMST Report (Appendix B) and mapped BIAs in the region provided in the National Conservation Atlas for the South-East Marine Region (SEMR). The range of overlap between the light EMBA and seabird foraging areas ranges from 0.08–2.42%..

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.

7.5.4 Evaluation of Environmental Impacts

7.5.4.1 Fish and plankton

Fish and zooplankton may be directly or indirectly attracted to lights. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan *et al*., 2001), with traps drawing catches from up to 90 m (Milicich *et al*., 1992). Lindquist et al (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

Fishing activities in the region (including squid fishing, which uses bright lights directed onto the water surface) are common activities, and the lighting levels associated with the CSV and additional lighting sources (outside of the activity area) are not considered to be significantly different from these sources or make a significant additional contribution.

7.5.4.2 Turtles

Artificial light can disrupt turtles during nesting and hatching; and is listed as a key threat in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017). Although listed turtle species (see Section 5.5.8) may infrequently occur within the light EMBA, there are no BIAs or turtle nesting beaches offshore Victoria or Tasmania. Therefore, impacts of light to turtles are not expected, given the significant distance of the light EMBA to the nearest turtle nesting beach is 1,464 km in Ballina, northern NSW.

7.5.4.3 Cetaceans

There is no evidence to suggest that artificial light sources adversely affect the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly utilise acoustic senses to monitor their environment rather than visual sources (Simmonds *et al*., 2004), so light is not considered to be a significant factor in cetacean behaviour or survival.

7.5.4.4 Birds

Seabirds may be attracted to light glow at night time. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with the vessel, or mortality from starvation due to disrupted foraging at sea (Wiese *et al*., 2001 in DSEWPC, 2011a). This disorientation may also result in entrapment, stranding, grounding and interference with navigation (DoEE, 2020). The DoEE (2020) notes that seabird fledglings may be affected by lights up to 15 km away. Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al*., 2008) and that lighting can attract birds from large catchment areas (Wiese *et al*., 2001). The light may provide enhanced capability for seabirds to forage at night. Migrating seabirds may be attracted by the lights of the construction vessel, which may result in drawing them off course from their usual migration path (DoEE, 2020). DoEE (2020) reports that petrel species in the Southern Ocean may be unable to take off from a deck. There are no actions within the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-16 (DSEWPC, 2011a) that are compromised by light emissions associated with the activity.

A number of bird species have BIAs within the SEMR (Table 5-5).

Albatross and Petrels

Seven albatrosses are identified as having foraging, feeding or related behaviour and BIAs within the light EMBAs (see Appendix B), these being the Antipodean albatross (Figure 5-19), black-browed albatross, Campbell albatross, wandering albatross, Indian yellow-nosed albatross (Figure 5-20), Buller's albatross (Figure 5-21) and shy albatross (Figure 5-22) have BIAs for foraging that overlap the activity area or spill EMBA. These BIAs cover either most or all the SEMR (Commonwealth of Australia, 2015). It is likely these species will forage in the EMBA.

The National Recovery Plan for Threatened Albatrosses and Giant Petrels 2001-2016 (DSEWPC, 2011a) does not identify light pollution as a threat to albatrosses and giant petrels. Given the small area of overlap with albatross foraging BIAs for the light EMBA and that available information indicates that these species are likely to forage most actively during daylight (see Section 5.5.7), the impact of light emissions on albatross is expected to be minimal.

The light EMBA overlaps the common diving-petrel's BIA (Figure 5-23). This species does not have a recovery plan or conservation advice in place. Common diving petrels spend the night in burrows during the breeding season and forage mainly during the day, although they also forage at night on vertically migrating plankton. It is thought they are fairly sedentary, remaining more or less in the area of their breeding colony all year round, although they may venture into the open ocean to forage outside of the breeding season, with some studies suggesting seasonal movements (Brooke, 2004 as cited on Animal Diversity Web, 2020). It is possible that common diving-petrel may forage at night within the light EMBA.

Terns

The Australian fairy tern is identified in the light EMBA PMST reports (Appendix B) as likely to be present for foraging, feeding or related behaviour. No BIAs or habitat critical to the survival of this species occur within the light EMBA. The Draft National Recovery Plan for the Australian Fairy Tern (Commonwealth of Australia, 2019) and the approved conservation advice (DSEWPC, 2011b) do not identify light emissions as a threat to the fairy tern. Because this species roosts on beaches at night (DoEE, 2020), it is unlikely these birds will be impacted by light from the activity.

Shearwaters

The light EMBA overlap the foraging BIAs for both the short-tailed shearwater (Figure 5-25) and the wedge-tailed shearwater (Figure 5-26). Light pollution from offshore sources is not identified as a threat to either of these birds (DAWE, 2022b). No habitat critical for the survival of the short-tailed shearwater occurs within the light EMBA. Impacts from light emissions are not predicted in general, as adult short-tailed shearwaters return to their colonies at dark after feeding at sea during the daytime (Australian Antarctic Division, 2010).

Warham (1996) as cited by Beaver (2018) states that the wedge-tailed shearwater forms large aggregations referred to as "rafts" offshore from their breeding colony just on dusk and enter and leave the colony at night to avoid predators. As such, impacts to the wedge-tailed shearwater from light emissions, which are generally more pronounced at night than during the day, are not expected.

Orange-bellied parrot

The orange-belled parrot is not listed in the light EMBA PMST report (Appendix B) but is recorded in the spill EMBA as present for the purposes of foraging, feeding or related behaviour. There is no BIA within the light EMBA, however the known migration area that covers King Island (and southeast of the island) occurs less than 80 km and 77 km to the east (Figure 5-27). The National Recovery Plan for the orange-bellied parrot states that illuminated structures and boats are a potential barrier to migration and movement of these birds (DELWP, 2016).

Given that the timing of the activity (i.e., a window between 1st December 2022 and 31st May 2023) has no overlap with the migration period south to Tasmania (from September to November), it is unlikely that light emissions from the activity will have any impact on the orange-bellied parrot.

7.5.4.5 Other receptors

There are no islands (shorelines) or shorebird colonies within the light EMBA (Figure 7.8). The distance from the closest point of the activity area to the nearest shoreline (45 km) means that vessel lighting is not visible from land and the impacts of light from the CSV to coastal bird populations will not occur.

In addition, due to the absence of seabird breeding colonies within the activity area (it is 99 km northwest of the little penguin and short-tailed shearwaters IBA on King Island and 45 km southwest of the Great Otway National Park IBA), light glow from small temporary light sources on the CSV will not result in impacts to those species at the population level or ecosystem level.

7.5.5 Impact Assessment

Table 7-8 presents the impact assessment for light emissions from the activity area. An assessment of the light emissions from the Geographe subsea installation and commissioning activity has been prepared as part of the Seabird Light Management Plan for the Otway Development Drilling and Well Abandonment (Rev 0, 2021). Control measures from the management plan are outlined in Table 7-8 where applicable.

Table 7-8: Impact assessment for light emissions

Summary			
Summary of impacts	Artificial light may act as an attractant to light-sensitive species (e.g., seabirds, fish, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).		
Extent of impacts	Highly localised (small radius of light glow around the CSV). Localised.		
Duration of impacts	Temporary - duration of activity.		
Level of certainty of impacts	HIGH - the impacts of light glow on marine fauna are relatively well known, however there is the potential for uncertainty in relation to the level of impact.		
Impact decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, good practice not well defined or met by more than one option.		
Impact Consequence (inherent)			
Minor			
Assessment of Proposed Control Measures			
Control measure	Control type	Adopted	Justification

Maintain a dark zone between rookeries and light sources.	Eliminate	Yes	At its closest, the light EMBA is approximately 35 km from islands or shorelines where rookeries may be located. Therefore, a dark zone between rookeries and the light sources will be maintained purely as a result of the activity location.
Turn off lights during fledgling season.	Eliminate	No	At its closest, the light EMBA is approximately 35 km from islands or shorelines where rookeries may be located. As no impact to fledglings is predicted, adopting this the control does not have an environmental benefit.
Reduce vessel external lighting to levels required for safe vessel navigation and safe operations on deck.	Engineering	Yes	Good practice is well defined and established in Marine Orders (Part 30 and Part 59) for vessels operating at sea. Lighting is required to provide navigational safety and meet legislative requirements. Lighting is reduced to the lowest practicable level managed such that to allow for safe work can be conducted safely practices and legislative compliance.
Aim CSV lights downwards and direct them away from nesting areas.	Engineering	No	At its closest, the light EMBA is approximately 35 km from islands or shorelines where rookeries may be located. As no impact to rookeries is predicted, adopting this e control does not have an environmental benefit.
Prevent indoor lighting reaching outdoor environment (as per DoEE, 2020).	Engineering	Yes	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 CSV.
Lighting directed overboard can be manually overridden (with a local switch where possible) such that it is only switched on as required (e.g., man overboard).	Engineering	Yes	Good practice and well established in the industry. Environmental benefit of reducing light spill outweighs the cost.
Lower screens and blinds on portholes and windows at night to reduce light spill to the environment.	Engineering	Yes	Good practice and well established in the industry. Environmental benefit of reducing light spill outweighs the cost.
Reduce unnecessary deck lighting on all vessels in known seabird foraging areas at sea (as per DoEE, 2020).	Engineering	Yes	Measures to manage light, including appropriate use and types of lights, as per Beach's Seabird Lighting Management Plan: Otway Development Drilling and Well Abandonment (Rev 0, 2021), which has been developed by Australia's leading expert on artificial light impact assessment and management. Restricting lighting at night has the environmental benefit of reducing impacts to seabirds.
Use flashing/intermittent lights instead of fixed beam (as per DoEE, 2020).	Engineering	No	At its closest, the light EMBA is approximately 35 km from islands or shorelines where rookeries may be located. As no impact to fledglings is predicted, adopting this the control does not have an environmental benefit.
Use motion sensors to turn lights on only when needed (as per DoEE, 2020).	Engineering	No	The activity is temporary and the evaluation of impacts indicates limited impact to seabirds. As such, the cost associated with switching all outdoor lights over to motion sensors is not proportionate to the negligible environmental benefit in adopting this measure.

Avoid lights containing short wavelength violet/blue light (as per DoEE, 2020).	Engineering	No	The activity is temporary and the evaluation of impacts indicates limited impact to seabirds. As such, the cost associated with switching all outdoor lights over to different bulbs is not proportionate to the negligible environmental benefit in adopting this measure.
Avoid use of white LEDs (as per DoEE, 2020).	Engineering	No	The activity is temporary and the evaluation of impacts indicates limited impact to seabirds. the cost associated with switching all outdoor lights over to white LEDs is not proportionate to the negligible environmental benefit in adopting this measure.
Timing of activity.	Administrative	No	The activity is planned to be undertaken between between 1st December 2022 and 31st May 2023for a duration of up to 30 days. The following seasonal timings were identified for species that may be active at night within the activity light EMBA: Common diving petrel: year-round (NCVA, 2020). Controls have been identified to ensure lighting on the CSV is reduced to that for safe operations. Other species are present all year round or do not forage at night, so changing the period when the activity will occur does not afford any benefit to these species.
Implement management actions during the breeding season. Light management should be implemented during the nesting and fledgling periods.	Administrative	No	At its closest, the light EMBA is approximately 35 km from islands or shorelines where nesting and fledglings may be located. As no impact to nesting or fledglings is predicted, the control does not have an environmental benefit.
Vessels 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 (as per DoEE, 2020).	Administrative	Yes	As the activity will take place when seabirds may be foraging or migrating within the light EMBA, the activity will adopt Beach's Seabird Lighting Management Plan: Otway Development Drilling and Well Abandonment, which has been developed in line with the National Light Pollution Guidelines for Wildlife (DoEE, 2020).
Design and implement a rescue program for grounded birds.	Administrative	Yes	A rescue program will not prevent birds grounding, but it has proven useful to reducing mortality of seabirds and therefore has an environmental benefit. The activity will adopt the grounded bird rescue procedures provided in Beach's Seabird Lighting Management Plan: Otway Development Drilling and Well Abandonment.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
External vessel lighting conforms to that required by maritime safety standards.	Light glow is minimised by managing external vessel lighting in accordance with: AMSA Marine Orders Part 30 (Prevention of Collisions). AMSA Marine Orders Part 59 (Offshore Support Vessel Operations).	Vessel class certifications are current.

Attraction to lights for birds and marine fauna is kept for a minimum.	All non-essential lights will be turned off when not in use, where possible.	Completed vessel inspection checklists and photos verify that lights are directed inboard, and where this is not possible, lights are switched off when not in use.
	Lighting is directed to working areas (rather than overboard) to minimise light spill to the ocean.	
	Window screens or blinds will be closed at night.	Completed daily environmental checklists and photos verify that blinds are drawn each night.
	Non-emergency activities that require illumination of non-continuous light sources at night will be avoided during poor visibility, where possible.	Completed daily environmental checklists verify illumination of non-continuous light sources at night were not in use during
Monitoring and recording of bird interactions are conducted throughout the activity.	Beach Offshore Representative will report grounded or injured birds on the CSV to the Beach Principal Environmental Advisor.	Completed incident reports are available.
	All crew are informed of their reporting responsibilities for grounded or injured birds during the environmental induction.	Induction presentation includes reporting responsibilities for grounded or injured birds.
		Signed induction sheet from all crew indicated they have received and understood the induction.
	Incidents of grounded or injured birds on the vessel will be handled in accordance with the Seabird Lighting Management Plan: Otway Development Drilling and Well Abandonment (Rev 0, 2021).	Completed incident reports are available.

Impact Consequence (residual)
Minor
The consequence of light emissions is assessed as negligible because the activity is of a temporary nature (60 days); there are no seabird breeding colonies within 20 km of the activity area; the overlap between of the light EMBA and BIA foraging areas is negligible; wildlife potentially vulnerable to light (e.g., seabirds) will not be disrupted, nor displaced from important habitat and will be able to undertake critical behaviours such as foraging and reproduction; and the control measures adopted are commensurate with the inherent level of impact consequence.
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. The following ALARP analysis in addition to the Seabird Light Management Plan: Otway Development Drilling and Well Abandonment and provides additional assurance that all risk treatment options have been considered. Control measures that have been considered to reduce the impacts of light emissions on biological receptors, but not adopted, are outlined below.

Demonstration of Acceptability		
Defined acceptable level	Light emissions are not inconsistent with recovery plans or wildlife conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species. Beach considers it acceptable to have a Level 1 (minor) or Level 2 (moderate) consequence to a marine fauna population or ecological community.	
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.

Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by relevant persons about impacts from lighting with this activity.	
Legislative context	The EPS outlined in this EP align with the requirements of: Navigation Act 2012 (Cth): Part 3 (Prevention of Collisions). AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). AMSA Marine Orders Part 30 (Prevention of Collisions).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: Light emissions – minimise external lighting to that required for navigation and safety, limit the occurrence and duration of flaring (where possible).
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding lighting for offshore activities.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS listed in this table meet these guidelines with regard to: Ship collision (item 120). To avoid collisions with third-party vessels, offshore facilities should be equipped with navigational aids that meet national and international requirements, including navigational lights on vessels.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the impact of planned air emissions, noise emissions and light to ALARP and to an acceptable level.
	Light-specific guidance	
	The National Light Pollution Guidelines for Wildlife (DoEE, 2020)	The Seabird Light Management Plan: Otway Development Drilling and Well Abandonment (Rev 0, 2021) will include the most relevant controls for mitigating the impact of light on seabirds from the National Light Pollution Guidelines (DoEE, 2020). The Seabird Light Management Plan: Otway Development Drilling and Well Abandonment (Rev 0, 2021) will address the following: Lighting (by activity); Seabird population and behaviour within the light EMBA; Risk assessment; Mitigation and control measures based on the Seabird Light Mitigation Toolbox, and at a minimum will consider: Light shielding or alternative lighting methods (if feasible). 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. Biological and light monitoring and auditing; and

		Rescue program for grounded birds land on the CSV. This assessment indicates that many of the measures relating to seabirds in these guidelines are not applicable or not achievable for the activity based on its location being remote from seabird rookeries. Measures relating to turtles and shorebirds are not applicable.
Environmental context	MNES	
	AMPs	The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies light pollution associated with offshore mining operations and other offshore activities as a threat to the AMP network. The EPS listed in this table aimed at minimising light pollution emitted from the CSV do not conflict with the strategies outlined in the plan that aim to address this threat.
	Wetlands of international importance	Localised light glow will not have any impacts on Ramsar wetlands.
	TECs	Localised light glow will not have any impacts on TECs.
	NIWs	Localised light glow will not have any impacts on nationally important wetlands.
	Nationally threatened and migratory species	Localised light glow does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks	Localised light glow does not have any impacts on state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The management actions listed for seabirds in The National Light Pollution Guidelines for Wildlife (DoEE, 2020) have been considered. The National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC, 2011a) does not list artificial lighting as a key threat. The Draft National Recovery Plan for the Australian Fairy Tern (Commonwealth of Australia, 2019) and the approved conservation advice (DSEWPC, 2011) do not identify light emissions as a threat to the fairy tern. The National Recovery Plan for the Orange-bellied Parrot (DELWP, 2016) states that illuminated boats are a potential barrier to migration and movement of these birds. The impact of this activity has been assessed. The Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) is not relevant given the rare sightings of vagrant turtles and absence of turtle BIAs and nesting beaches in Bass Strait.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Comparison with defined acceptable level of impact	Beach considers the level of impact from light emissions to be of an acceptable level. The impacts of this hazard are acceptable because the evaluation of impacts predicts that lighting impacts will be minor. Potentially vulnerable wildlife to artificial light (e.g., seabirds) will not be disrupted, nor displaced from important habitat and will be able to undertake critical behaviours such as foraging, reproduction and dispersal. The activity will not compromise the objectives set out in applicable recovery plans or wildlife conservation plans/ advice that are in force for threatened and migratory species.	

Environmental Monitoring
Fauna interactions with lighting.
Record Keeping
Vessel class certification. Vessel inspection checklists. Vessel crew induction presentation and sign-out sheets. Daily environmental checklists. Daily HSE report. Incident reports.

7.6 IMPACT – Routine Emissions – Atmospheric

7.6.1 Hazards

The following activities generate atmospheric emissions:

- Combustion of MDO from the vessel engines, generators and fixed and mobile deck equipment during the activity.

7.6.2 Known and potential environmental impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to gaseous emissions and particulates from MDO combustion; and
- Addition of GHG to the atmosphere (influencing climate change).

7.6.3 EMBA

The EMBA for atmospheric emissions associated is the local air shed – likely to be within hundreds of metres of the CSV, both horizontally and vertically.

Receptors that may occur within this EMBA, either as residents or migrants, are seabirds. Human populations in coastal settlements are too far north of the EMBA to be considered here.

7.6.4 Evaluation of Environmental Impacts

7.6.4.1 Localised and temporary decrease in air quality from diesel combustion

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 (SO_X) and nitrous oxides (NO_X). 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. In the activity area, this is limited to seabirds overflying the vessel/s.

Particulate matter released from the construction vessel is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Port Campbell located 54 km north of the activity area), as offshore winds will rapidly disperse and dilute particulate matter. This rapid dispersion and dilution will also ensure that seabirds are not exposed to concentrated plumes of particulate matter from vessel exhaust points.

7.6.4.2 Contribution to the GHG effect

The use of fuel to power engines, generators and any mobile/fixed plant will result in gaseous emissions of GHG such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are relatively small on a global scale, representing an insignificant contribution to overall GHG emissions. The activity is similar to other industrial activities contributing to the accumulation of GHG in the atmosphere.

7.6.5 Impact Assessment

Table 7-9 presents the impact assessment for atmospheric emissions.

Table 7-9: Impact assessment from atmospheric emissions

Summary		
Summary of Impacts	Decrease in air quality due to gaseous emissions and particulates from diesel combustion and contribution to the incremental build-up of GHG in the atmosphere (influencing climate change).	
Extent of impacts	Localised (local air shed for air quality), widespread (for GHG).	
Duration of impacts	Temporary - duration of activity (emissions are rapidly dispersed and diluted).	
Level of certainty of impact	HIGH – the impacts of atmospheric emissions are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Combustion systems operate in accordance with MARPOL Annex VI (Prevention of Air Pollution from Ships) requirements.	Only low-sulphur (<0.5% m/m) MDO will be used in order to minimise SOx emissions.	Bunker receipts verify the use of low-sulphur MDO.
	All combustion equipment is maintained in accordance with the PMS (or equivalent).	PMS records verify that combustion equipment is maintained to schedule.
	Vessels with gross tonnage >400 tonnes possess equipment, systems, fittings, arrangements and materials that comply with the applicable requirements of MARPOL Annex VI.	Air Pollution Prevention Certificate (IAPP) is current.
	Vessels >400 gross tonnes and involved in an international voyage implement their Ship Energy Efficiency Management Plan (SEEMP) to monitor and reduce air emissions.	SEEMP records verify energy efficiency records have been adopted.
	Vessels >400 gross tonnes must ensure that firefighting and refrigeration systems are managed to minimise Ozone Depleting Substances (ODS).	ODS record book is available and current.
Solid combustible waste will only be burned within an	Only a MARPOL VI-approved incinerator is used to incinerate solid combustible waste (food waste, paper, cardboard, rags, plastics).	IMO incinerator certificate verifies the incinerator meets MARPOL requirements.

incinerator, and only if logistics don't allow for the timely removal of waste from the vessel.	Incineration is only conducted when the vessel is >12 nm from the shore.	Activity-specific discharges and emissions register indicates no incineration within 12 nm of the shore.
	Oil and other noxious liquid substances will not be incinerated.	The Oil Record Book and Garbage Record Book verify that waste oil and other noxious liquid substances are transferred to shore for disposal.
Fuel use will be measured, recorded and reported.	Fuel use will be measured, recorded and reported for abnormal consumption, and in the event of abnormal fuel use, corrective action is taken to minimise air pollution.	Fuel use is recorded in the daily operations reports.

Impact Consequence (residual)
Minor
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	• Management system compliance	• Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all relevant persons , and actively involved relevant persons known to have concerns with the activity. There has been no concern expressed by relevant persons about impacts from atmospheric emissions with this activity.	
Legislative context	The performance standards outlined in this EP align with the requirements of: *Navigation Act* 2012 (Cth): Chapter 4 (Prevention of Pollution). AMSA Marine Order Part 79 (Marine pollution prevention – air pollution). *Protection of the Sea (Prevention of Pollution by Ships) Act 1983* (Cth): Part IIID (Prevention of Air Pollution). AMSA Marine Orders Part 97 (Air Pollution), enacting MARPOL Annex VI (especially Regulations 6, 14, 16). *National Greenhouse and Energy Reporting Act* 2007 (Cth).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: Section 4.4.3 - Combustion emissions; Use of high efficiency equipment to minimise power demand. Selection of low sulphur diesel. Regular plant maintenance. Regular maintenance and emission control devices on vehicles and machinery.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon	• The EPS listed in this table meet these guidelines for offshore activities with regard to management of

	Exploration and Production (European Commission, 2019)	fugitive emissions (item 22). The BAT are met for the construction vessel.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	• Guidelines met with regard to: Air emissions (item 11). The overall objective to reduce air emissions. Air emissions (item 12). During equipment selection, air emission specifications should be taken into account, as should the use of very low sulphur content fuels and/or natural gas.
	APPEA CoEP (2008)	• Objectives regarding atmospheric emissions from offshore development and production are: To reduce the impact of planned air emissions, noise emissions and light to ALARP and to an acceptable level. • The performance standards listed in this table meet these objectives.
Environmental context	MNES	
	AMPs	Atmospheric emissions will not directly affect nearby AMPs.
	Wetlands of international importance	Atmospheric emissions will not directly affect any Ramsar wetlands.
	TECs	Atmospheric emissions will not directly affect any TECs.
	NIWs	Atmospheric emissions will not directly affect any nationally important wetlands.
	Nationally threatened and migratory species	Atmospheric emissions will not directly affect threated or migratory species.
	Other matters	
	State marine parks	Atmospheric emissions will not directly affect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC, 2011a) lists climate change as a key threat, though the most pervasive threat is accidental mortality and injury from interactions with fishing activities. The Recovery Plans and Conservation Advice for the Blue, Sei, Fin and Southern Right Whales lists climate change as a key threat, though the most pervasive threats are whaling, vessel strike and entanglement. The Recovery Plan for Marine Turtles in Australia lists climate change as a key threat. The Recovery Plan for the Orange-bellied parrot lists climate change as a key threat, though the most pervasive threat is loss of habitat.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
Fuel use.		
Record Keeping		

Vessel PMS records.	ODS record book.
Vessel fuel use records.	Oil record book.
Vessel bunkering receipts.	Garbage record book.
Waste manifests (for incineration).	Activity-specific discharges and emissions register.

7.7 IMPACT – Routine Discharges - Putrescible Waste

7.7.1 Hazards

The generation of food waste (putrescible waste) from the vessel galley will result in the overboard discharge of this waste. The average volume of putrescible waste discharged overboard depends on the number of POB at any time, and the types of meals prepared. However, some anecdotal reports estimate this volume to be in the order of 1-2 kg per person per day (NERA, 2017).

7.7.2 Known and potential environmental impacts

The known and potential environmental impacts of putrescible waste discharges are:

- Temporary and localised increase in the nutrient content of waters surrounding the discharge point; and
- An associated increase in scavenging behaviour of marine fauna and seabirds (at the sea surface or within the water column).

7.7.3 EMBA

The EMBA for putrescible waste discharges is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex, Western Australia).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans, pinnipeds); and
- Avifauna.

7.7.4 Evaluation of Environmental Impacts

The overboard discharge of macerated food wastes creates a localised and temporary increase in the nutrient load of near-surface waters. This in turn acts as a food source for scavenging marine fauna and/or seabirds, whose numbers may temporarily increase as a result. The rapid consumption of putrescible waste by scavenging fauna, and its physical and microbial breakdown, ensures that the impacts of such discharges are insignificant.

The impacts of putrescible waste discharges to the physical and biological environment are expected to have insignificant consequences because of the:

- Small discharge volumes;
- Intermittent nature of the discharge;
- Maceration of the waste prior to discharge;
- High dilution and dispersal factor in open waters;
- Long distance from shore;
- Rapid consumption by fauna;

- High biodegradability and low persistence of the waste; and
- The absence of sensitive habitats in the activity area.

7.7.5 Impact Assessment

Table 7-10 presents the impact assessment for putrescible waste discharges.

Table 7-10: Impact assessment for putrescible waste discharges

Summary		
Summary of impacts	Increase in nutrient content of near-surface waters around the discharge point, which may lead to an increase of scavenging behaviour of pelagic fish and seabirds.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Intermittent and temporary – until the discharge is completely diluted (likely to be several hours).	
Level of certainty of impacts	HIGH – the impacts of putrescible waste discharges on marine fauna are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Putrescible waste discharges comply with AMSA Marine Order 95 (Marine pollution prevention – garbage), which enacts MARPOL Annex V.	A MARPOL Annex V-compliant Garbage Management Plan (GMP) is in place (for vessels >100 GRT tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	A GMP is in place, readily available onboard and kept current.
	A MARPOL Annex V-compliant macerator is on board the CSV, functional, in use and set to macerate putrescible waste to a particle size ≤25 mm using to ensure rapid breakdown upon discharge.	PMS records verify that the macerator is functional and regularly maintained or replaced.
	Waste management and housekeeping requirements are communicated to all personnel boarding the CSV to ensure discharges are in accordance with MARPOL Annex V.	Vessel induction includes waste management requirements.
	Records of food waste disposal to be maintained in a Garbage Record Book.	A Garbage Record Book is in place and verifies waste discharge locations and volumes.
	Macerated putrescible waste (≤25 mm) is only discharged overboard when the CSV is >3 nm from the shoreline.	
	Un-macerated putrescible waste is only discharged overboard when the CSV is >12 nm from the shoreline.	
	Non-putrescible galley waste is returned to shore for disposal.	
Impact Consequence (residual)		
Minor		

Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by relevant persons s about impacts from putrescible waste discharges for this activity.	
Legislative context	The performance standards outlined in this EP align with the requirements of: *Navigation Act* 2012 (Cth): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order 95 (Marine Pollution Prevention - garbage). *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): o Section 26F (which implements MARPOL Annex V).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: Section 4.5.1 - organic (food) waste from the kitchen should, at a minimum, be macerated to <25 mm prior to discharge to sea, in compliance with MARPOL Annex V requirements.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: Environmental monitoring (item 26). The BAT are met for the activity with regard to monitoring waste streams.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: Other waste waters (item 44). Food waste from the kitchen should, at a minimum, be macerated to acceptable levels and discharged to sea, in compliance with MARPOL requirements.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Putrescible waste discharges will not intersect nearby AMPs.
	Wetlands of international importance	Putrescible waste discharges will not intersect any Ramsar wetlands.
	TECs	Putrescible waste discharges will not intersect any TECs.
	NIWs	Putrescible waste discharges will not intersect any nationally important wetlands.
	Nationally threatened and migratory species	Putrescible waste discharges will not have any significant impacts on threated or migratory species.

	Other matters	
	State marine parks	This hazard will not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The discharge of putrescible waste does not compromise the specific objectives or actions (regarding marine pollution) of the Albatross and Giant Petrels Recovery Plan (DSEWPC, 2011a) or any of the other species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
Volume/weight of non-macerated waste sent ashore.		
Record Keeping		
GMP.	Training matrix.	
PMS records.	Induction records.	
Garbage Record Book.		

7.8 IMPACT – Routine Discharges - Sewage and Grey Water

7.8.1 Hazards

The use of ablution, laundry and galley facilities by vessel crews will result in the discharge of sewage and grey water. While the number of personnel onboard the vessel/s at any one point in time is currently unknown, this activity will result in the discharge of several hundred litres of treated sewage and greywater each day.

7.8.2 Known and potential environmental impacts

The known and potential environmental impact of treated sewage and grey water discharges is:

- Temporary and localised increase in the nutrient content of surface waters around the vessels.

7.8.3 EMBA

The EMBA for sewage and grey water discharges associated with vessel activities is likely to be the top 10 m of the water column and a 50 m radius from the discharge point. This is based on modelling of continuous wastewater discharges (including treated sewage and greywater) undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found:

- Rapid horizontal dispersion of discharges occurs due to wind-driven surface water currents;
- Vertical discharge is limited to about the top 10 m of the water column due to the neutrally buoyant nature of the discharge; and
- A concentration of a component within the discharge stream is reduced to 1% of its original concentration at no less than 50 m from the discharge point under any condition (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and pinnipeds); and
- Seabirds.

7.8.4 Evaluation of Environmental Impacts

7.8.4.1 Water quality

Nutrients in sewage, such as phosphorus and nitrogen, may contribute to eutrophication of receiving waters (although usually only still, calm, inland waters and not offshore waters), causing algal blooms, which can degrade aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans. Given the tidal movements and currents in the open oceanic waters of the activity area, eutrophication of receiving waters will not occur. Sewage will be treated through STPs to a tertiary level, so there are no impacts relating to the release of chemicals and pathogens in untreated sewage.

Grey water can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, food waste, coliform bacteria and some medical waste. Grey water is treated through the STP, so pollutants will be largely removed from the discharge stream.

The effects of sewage and sullage discharges on the water quality at Scott Reef were monitored for a drill rig operating near the edge of the deep-water lagoon area at South Reef. Monitoring at stations 50 m, 100 m and 200 m downstream of the rig and at five different water depths confirmed that the discharges were rapidly diluted in the upper 10 m water layer and no elevations in water quality monitoring parameters (e.g., total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the high numbers of personnel onboard a drill rig (typically 100-120) compared with the likely number of personnel on the CSV.

Treated sewage and grey water discharges will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand of the treated effluent is unlikely to lead to oxygen depletion of the receiving waters (Black *et al*., 1994), as it will be treated prior to release. On release, surface water currents will assist with oxygenation of the discharge.

7.8.4.2 Biological receptors

Plankton forms the basis of all marine ecosystems, and plankton communities have a naturally patchy distribution in both space and time (ITOPF, 2011a). They are known to have naturally high mortality rates (primarily through predation), however in favourable conditions (e.g., supply of nutrients), plankton populations can rapidly increase. Once the favourable conditions cease, plankton populations will collapse and/or return to previous conditions. Plankton populations have evolved to respond to these environmental perturbations by copious production within short generation times (ITOPF, 2011a).

Any potential change in plankton diversity, abundance and composition as a result of treated sewage and grey water discharges is expected to be very low (given the waste stream is treated) and localised (as per the EMBA), and is likely to return to background conditions within tens to a few hundred metres of the discharge location (NERA, 2017). Accordingly, impacts higher up the food chain (e.g., fish, reptiles, birds and cetaceans) are expected to be minor.

7.8.4.3 Social impacts

Treated sewage and grey water discharges will not have any impacts social activities in or around the activity area because of the long distance between recreational beaches (swimming and fishing) and the activity area (and most vessel-related activities) and because there are no recognised dive sites (e.g., shipwrecks, reefs) in the activity area.

7.8.5 Impact Assessment

The impacts of treated sewage and grey water discharges to the physical, biological and social environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- Treatment of the waste stream prior to discharge;
- High dilution and dispersal factor in open waters;
- Distance from shore;
- High biodegradability and low persistence of the waste; and
- Absence of sensitive habitats in the activity area.

Table 7-11 presents the impact assessment for the discharge of treated sewage and grey water.

Table 7-11: Impact assessment for the discharge of treated sewage and grey water

Summary		
Summary of impacts	Reduction in water quality around the discharge point, increase in nutrients.	
Extent of impacts	Localised – up to 50 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Temporary – until the discharge is completely diluted (likely to be minutes to hours).	
Level of certainty of impact	HIGH – the impacts of sewage and grey water discharges water quality are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Sewage and grey water is treated prior to overboard discharge in accordance with Regulation 9 of MARPOL Annex IV.	Where sewage is treated in a STP, the STP meets MARPOL standards.	ISPP certificate is valid and verifies the installation of a MARPOL-approved STP.
	The STP is maintained in accordance with the vessel's PMS.	PMS records confirm that the STP is maintained to schedule.
There is no discharge of treated or untreated sewage and grey water in state waters (<3 nm from shore).	In accordance with Regulation 11 of MARPOL Annex IV (as enacted by Marine Order 96), sewage is comminuted, disinfected and only discharged when: Vessel is >3 nm from nearest land. Sewage originating in holding tanks is discharged at a moderate rate while the vessel is proceeding en route at a speed not <4 knots.	Records verify that treated sewage is only discharged when the vessel is >3 nm from shore.
Untreated sewage will only be discharged when the	In the event of a STP malfunction, untreated sewage and grey water is only discharged when the vessel is >12 nm from shore in accordance	Activity-specific discharges and emissions register verifies that untreated sewage is

vessel is greater than 12 nm from shore.	with Regulation 11 of MARPOL Annex IV (enacted by AMSA Marine Orders Part 96, Sewage).	only discharged when the vessel is >12 nm from shore.
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	There has been no concern expressed by relevant persons s about impacts from sewage and grey water discharges for this activity.	

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Navigation Act* 2012 (Cth):
	  ○ Chapter 4 (Prevention of Pollution).
	  ○ AMSA Marine Order 95 (Marine Pollution Prevention - sewage).
	• *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth):
	  ○ Section 26D (which implements MARPOL Annex IV).	

Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed in Section 4.5.1 - offshore discharges (sewage and grey water): Grey and sewage water from showers, toilets, and kitchen facilities should be treated in an appropriate on-site marine sanitary treatment unit. Sewage units to be in compliance with MARPOL Annex V requirements.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to managing sewage and grey water discharges.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: Other waste waters (item 44). Grey and black water should be treated in an appropriate on-site marine sanitary treatment unit in compliance with MARPOL.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore production and development objectives: To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Sewage and grey water discharges will not intersect nearby AMPs.

	Wetlands of international importance	Sewage and grey water discharges will not intersect any Ramsar wetlands.
	TECs	Sewage and grey water discharges will not intersect any TECs.
	NIWs	Sewage and grey water discharges will not intersect any NIWs.
	Nationally threatened and migratory species	Sewage and grey water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks	Sewage and grey water discharges will not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
None required.		
Record Keeping		
ISPP certificate. STP PMS records. Activity-specific discharges and emissions register.		

7.9 IMPACT – Routine Discharges - Cooling and Brine Water

7.9.1 Hazard

Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Brine is created through the desalination processes for potable water generation. Seawater is used as a heat exchange medium for cooling engines and other equipment. Seawater is drawn up from the ocean, where it is de-oxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers (in the process transferring heat from the machinery) and is then discharged to the ocean at depth (not at surface). Upon discharge, it will be warmer than the ambient water temperature and may contain low concentrations of residual biocide and scale inhibitors if they are used to control biofouling and scale formation.

The maximum cooling water discharge rate for the CSV that may be used is unknown. Also unknown is the temperature at which the heat exchangers are designed to discharge the cooling water at (generally several degrees celsius above ambient sea temperature).

Brine water (hypersaline water) is created through the desalination process that creates freshwater for drinking, showers, cooking etc. This is achieved through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). The freshwater produced is then stored in tanks on board. Upon discharge, the concentration of the brine is (based on other modern vessels) likely to range from 44-61 ppm, which is 9-26 ppm higher than seawater salt concentration (35 ppm). Brine concentration is dependent on throughput and plant efficiency.

7.9.2 Known and potential environmental impacts

The known and potential environmental impacts of cooling water and brine discharges are:

- Temporary and very localised increase in sea water temperature, causing thermal stress to marine biota;
- Temporary and very localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna from the ingestion of residual biocide and scale inhibitors.

7.9.3 EMBA

The EMBA for cooling water and brine discharges associated with vessel activities is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.9.4 Evaluation of Environmental Impact

7.9.4.1 Temporary and localised increase in seawater temperature

Once in the water column, cooling water will remain in the surface layer, where turbulent mixing and heat transfer with surrounding waters will occur. Prior to reaching background temperatures, the impact of increased seawater temperatures down current of the discharge may result in changes to the physiological processes of marine organisms, such as attraction or avoidance behaviour, stress or potential mortality. impacts to most receptors are expected to be negligible within the small mixing zone.

7.9.4.2 Temporary and localised increase in sea surface salinity

Brine water will sink through the water column where it will be rapidly mixed with receiving waters and be dispersed by ocean currents. Walker and MacComb (1990) found that most marine species are able to tolerate short-term fluctuations in water salinity in the order of 20-30%, and it is expected that most pelagic species passing through a denser saline plume would not suffer adverse impacts. Other than plankton, pelagic species are mobile and would be subject to slightly elevated salinity levels for a very short time as they swim through the 'plume.' As such, impacts to receptors are expected to be negligible.

7.9.4.3 Potential toxicity impacts

Scale inhibitors and biocide are likely to be used in the heat exchange and desalination process to avoid fouling of pipework. Scale inhibitors are low molecular weight phosphorous compounds that are water-soluble, and only have acute toxicity to marine organisms about two orders of magnitude higher than typically used in the water phase (Black *et al*., 1994). The biocides typically used in the industry are highly reactive and degrade rapidly and are very soluble in water (Black *et al*., 1994).

These chemicals are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process, ensuring there is little or no residual chemical concentration remaining upon discharge.

7.9.5 Impact Assessment

The impacts of cooling and brine water discharges to the physical and biological environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- 'Consumption' of the chemicals prior to discharge;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the activity area.

Table 7-12 presents the impact assessment for the discharge of cooling and brine water.

Table 7-12: Impact assessment for the discharge of cooling and brine water

Summary		
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Temporary – during vessel operations.	
Level of certainty of impact	HIGH – the impacts of sea surface temperature and salinity increases on marine fauna are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
The RO plant and equipment that requires cooling by water is well maintained.	Plant and equipment that requires cooling by water is maintained in good working order in accordance with the vessels' PMS.	Vessel PMS records verify that equipment that requires cooling is maintained in accordance with OEM requirements.
Only water with low-toxicity chemical additives will be discharged from the cooling and brine water systems.	Only chemicals with an OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated chemicals (i.e., low toxicity) will be discharged from the cooling and brine water systems.	Vessel chemical inventories records verify that biocides and scale inhibitors are of low toxicity.
Impact Consequence (residual)		
Minor		

<table>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td rowspan="2">Internal context</td><td>Policy compliance</td><td>Beach Environmental Policy objectives are met through implementation of this EP.</td></tr>
<tr><td>Management system compliance</td><td>Chapter 8 describes the EP implementation strategy employed for this activity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity.
There has been no concern expressed by relevant persons about impacts from cooling and brine water discharges for this activity.</td></tr>
<tr><td>Legislative context</td><td colspan="2">There are no legislative controls regarding cooling and brine water discharges.</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this hazard are in line with the management measures listed for offshore discharges (cooling water and desalination brine) in Section 4.5.3 of the guidelines:
Biocide dosing kept to a minimum in accordance with the equipment manufacturer's specifications.
Freshwater generation to be limited to volumes necessary for operational requirements.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines for offshore activities with regard to managing cooling and brine water discharges.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
Cooling water (items 41 & 42). Antifouling chemical dosing to prevent marine fouling of cooling water systems should be carefully considered and appropriate screens to be fitted to the seawater intake to avoid entrainment and impingement of marine flora and fauna. The cooling water discharge depth should be selected to maximise mixing and cooling of the thermal plume to ensure it is within 3°C of ambient seawater temperature within 100 m of the discharge point.
Desalination brine (item 43). Consider mixing desalination brine from the potable water system with cooling water or other effluent streams.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:
To reduce the volume of wastes produced to ALARP and to an acceptable level.</td></tr>
<tr><td rowspan="3">Environmental context</td><td colspan="2">MNES</td></tr>
<tr><td>AMPs</td><td>Cooling and brine water discharges will not intersect nearby AMPs.</td></tr>
<tr><td>Wetlands of international importance</td><td>Cooling and brine water discharges will not intersect any Ramsar wetlands.</td></tr>
</table>

	TECs	Cooling and brine water discharges will not intersect any TECs.
	NIWs	Cooling and brine water discharges will not intersect any NIWs.
	Nationally threatened and migratory species	Cooling and brine water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks	Cooling and brine water discharges will not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
None required		
Record Keeping		
PMS records. Chemical inventories.		

7.10 IMPACT – Routine Discharges - Bilge Water and Deck Drainage

7.10.1 Hazard

Bilge tanks on vessels receive fluids from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats this water prior to discharge overboard in order to meet the MARPOL requirement that no greater than 15 ppm oil-in-water (OIW) is discharged overboard. The volume of these discharges is small and intermittent (as required, based on bilge tank storage levels). Where no OWS is present, these fluids are retained in tanks for onshore disposal.

Vessel decks that are not bunded and drain directly to the sea may lead to the discharge of contaminated water, caused by ocean spray and rain ('green water') or deck washing activities capturing trace quantities of contaminants such as oil, grease and detergents, or a chemical (e.g., hydraulic fluids, lubricating oils) or hydrocarbon spill or leak washed overboard.

7.10.2 Known and potential environmental impacts

The known and potential environmental impacts of the discharge of bilge water and deck drainage are:

- Temporary and localised reduction of surface water quality around the discharge point;
- Acute toxicity to marine fauna through ingestion of contaminated water in a small mixing zone.

7.10.3 EMBA

The EMBA for bilge and deck water discharges is likely to be the top 10 m of the water column and less than a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.10.4 Evaluation of Environmental Impact

7.10.4.1 Temporary and localised reduction of surface water quality

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges and traces of chemicals or hydrocarbons discharged to the ocean through open deck drainage may temporarily reduce water quality.

Given the absence of sensitive habitat types in the water column of the EMBA for these discharges, the greatest risk will be to plankton and pelagic fish. These discharges will be rapidly diluted, dispersed and biodegraded to undetectable levels within a very small mixing zone (as per the EMBA).

7.10.4.2 Potential toxicity impacts

While small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality, such discharges are not expected to induce acute or chronic toxicity impacts to marine fauna or plankton through ingestion or absorption through the skin.

In the event a vessel OWS malfunctions and discharges of off specification water, toxicity impacts may occur, though this is only likely in a highly localised mixing zone (meaning that few individuals would be exposed).

7.10.5 Impact Assessment

In general, the impacts of bilge water and deck drainage to the physical and biological environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the activity area and EMBA.

Table 7-13 presents the impact assessment for the discharge of bilge water and deck drainage.

Table 7-13: Impact assessment for the discharge of bilge water and deck drainage

Summary		
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Intermittent during vessel operations.	
Level of certainty of impacts	HIGH – the impacts of oily water discharges to the ocean are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Bilge water discharges comply with MARPOL Annex I requirements.	For vessels >400 gross tonnes, all bilge water passes through a MARPOL-compliant OWS set to limit OIW to <15 ppm prior to overboard discharge.	IOPP certificate is current.
	The OWS is maintained in accordance with the vessel PMS.	PMS records verify that the OWS is maintained to schedule.
	The OWS is calibrated in accordance with the vessel PMS to ensure the 15 ppm OIW limit is met.	PMS records verify that the OWS is calibrated to schedule.
No whole residual bilge oil is discharged overboard.	The residual oil from the OWS is pumped to tanks and disposed of onshore.	The Oil Record Book verifies that waste oil is transferred to shore.
Level 1 spills (<10 m^3) of oil or oily water overboard are rapidly responded to by the vessel contractor.	The vessel-specific Shipboard Marine Pollution Emergency Plan (SMPEP) is implemented in the event of an overboard spill of hydrocarbons or chemicals.	Incident report verifies that the SMPEP was implemented.
Planned open deck discharges are non-toxic.	Deck cleaning detergents are biodegradable.	Safety Data Sheets (SDS) verify that deck cleaning agents are biodegradable.
Hydrocarbon or chemical spills to deck are prevented from being discharged overboard.	Hydrocarbon and chemical storage areas (process areas) are bunded and drain to the bilge tank.	Site inspections (and associated completed checklists) verify that bunding is in place and piping and instrumentation diagrams (P&IDs) verify that, for vessels, they drain to the bilge tank.
	Portable bunds and/or drip trays are used to collect spills or leaks from equipment that is not contained within a permanently bunded area (non-process areas).	Site inspections (and associated completed checklists) verify that portable bunds and/or drip trays are used in non-process areas as required.
Personnel are competent in spill response and have appropriate resources to respond to a spill.	The vessel crews are competent in spill response and have appropriate response resources in order to prevent or minimise hydrocarbon or chemical spills discharging overboard.	Training records verify that vessel crews receive spill response training.
	Fully stocked SMPEP response kits and scupper plugs or equivalent drainage control measures are	Site inspections (and associated completed checklists) verify that fully stocked spill response kits and scupper

	readily available and used in the event of a spill to deck to prevent or minimise discharge overboard.	plugs (or equivalent) are available on deck in high-risk locations.
		Review of incident reports indicate that the spills of hydrocarbons or chemicals to deck are cleaned up.

Impact Consequence (residual)
Minor
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	There has been no concern expressed by relevant persons about impacts from bilge water and deck drainage discharges for this activity.	
Legislative context	The performance standards outlined in this EP align with the requirements of: • *Navigation Act* 2012 (Cth): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order 91 (Marine Pollution Prevention - oil). • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): o Part II (Prevention of pollution by oil). o Part III (Prevention of pollution by noxious substances).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore discharges (deck drainage and bilge water) in Section 4.5.2 of the guidelines: Vessels must have an IOPP Certificate (for vessels >400 gross tonnes) and equipped with MARPOL/IMO-compliant oil/water treatment system (as appropriate to vessel class). Hydrocarbon and chemical storage areas are to be bunded with no residues/spills permitted to enter the overboard drainage system unless it first goes through a closed drainage treatment system. Vessels to maintain an Oil Record Book (applicable to vessels >400 gross tonnes), including the discharge of dirty ballast or cleaning water. Discharge into the sea of oil or oily mixtures is prohibited except when the OIW of the discharge without dilution does not exceed 15 ppm. For support vessels, discharge of treated oily water to only occur when a vessel is en route. Contaminated deck drainage and bilge water to be contained and treated prior to discharge in accordance with EHS Guidelines for Offshore Oil and Gas Development 2015. If treatment to this standard is not

		possible, these waters should be contained and shipped to shore for disposal. • Extracted hydrocarbons from oil-in water separator systems to be stored in suitable containers and transported to shore for treatment and/or disposal by a certified waste oil disposal contractor.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Management of drain water (item 24). The BAT are met for vessel operations with regard to ensuring deck coaming is in place, maintaining a chemical inventory, implementing an inspection, maintenance and repair schedule and ensuring that personnel are trained in the use of spill kits.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: Other waste waters (item 44). Bilge waters from machinery spaces in vessels should be routed to the closed drain system or contained and treated before discharge to meet MARPOL requirements. Deck drainage water should be routed to separate drainage systems. This includes drainage water from process and non-process areas. All process areas should be bunded to ensure that drainage water flows into the closed drainage system.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore production and development objectives: To reduce the risk of release of substances into the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Bilge water and deck drainage discharges will not intersect nearby AMPs.
	Wetlands of international importance	Bilge water and deck drainage discharges will not intersect any Ramsar wetlands.
	TECs	Bilge water and deck drainage discharges will not intersect any TECs.
	NIWs	Bilge water and deck drainage discharges will not intersect any nationally important wetlands.
	Nationally threatened and migratory species	Bilge water and deck drainage discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks	Bilge water and deck drainage discharges will not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
None required		

Record Keeping	
PMS records.	P&IDs.
IOPP certificate.	SDS (for deck cleaning agents).
Oil Record Book.	Incident reports.
Crew training records.	SMPEP.
Inspection and checklist records.	

7.11 RISK – Displacement of or Interference with Third-party Vessels

7.11.1 Hazard

The physical presence of the CSV will result in the exclusion of third-party vessels for the duration of the activity in order to facilitate the safety of the CSV crew and third-party vessel operators, such as commercial and recreational fishing vessels and merchant vessels.

Note, this section deals with interference in a socio-economic sense; collisions hazards (and subsequent MDO spill impacts) are addressed in Section 7.14.

7.11.2 Known and potential environmental impacts

The known and potential impacts of the displacement of or interference with third-party vessels are:

- Displacement of third party vessels;
- Diversion of third-party vessels from their navigation paths; and
- Damage to or loss of fishing equipment and/or loss of commercial fish catches.

7.11.3 EMBA

The EMBA for the displacement or interference with third-party vessels is anywhere within the activity area (wherever vessel movements occur), and more specifically the immediate area around the two intersecting vessels.

Receptors in the EMBA include:

- Commercial fishers;
- Commercial and recreational fishing vessels; and
- Merchant vessels.

7.11.4 Evaluation of environmental risks

7.11.4.1 Displacement of third-party vessels

The presence of the CSV will temporarily exclude other users of the marine environment in order to protect the subsea infrastructure being installed and vessel crew. Given that the activity area is not within a shipping lane, no impacts to shipping activity or commercial fishing vessels are expected. In the worst case, the merchant vessel would be engaged to change course. This may result in a negligible increase in travel time and fuel cost for merchant vessels, but in the context of an entire journey, this is not considered significant.

The consequence of displacing other users, such as commercial and/or recreational fishers, is considered negligible given the very sparse use of the area by fishers (see Sections 5.6.4 and 5.6.7).

7.11.4.2 Interference with third-party vessels

In the event of a vessel-to-vessel collision, health and safety impacts are more likely than environmental impacts. Should the force of a collision be enough to breach a vessel hull, which is unlikely due to the stationary nature of the CSV, an MDO spill may eventuate (this is addressed in Section 7.16). Given the short duration of the activity and the low fishing intensity in the activity area, the risk of interference with third-party vessels is low.

7.11.4.3 Damage to or loss of fishing equipment and loss of catch

Commercial (and recreational) fishing vessels will be excluded from operating within the activity area for the duration of the activity. Interactions between the CSV with third-party vessels is likely to be minimal, mostly because of the stationary nature (or at times, slow movement) of the CSV and its high visibility (due to size). Due to this visibility, it is also unlikely that fishing gear (such as trawl nets) would be damaged, as fishing vessels would detour around the CSV once communication between the vessels is made.

In the event that third-party vessels enter the activity area, there is potential for fishing gear to become entangled in any in-water equipment deployed by the CSV, resulting in damage or loss for both parties. In addition to the cost of repairing or replacing this equipment, it could also result in the loss of income from caught fish during that fishing expedition.

7.11.5 Risk Assessment

Table 7-14 presents the risk assessment for the displacement of or interference with third-party vessels.

Table 7-14: Risk assessment for the displacement of or interference with third-party vessels

Summary			
Summary of risks	Presence of CSV (and in-water equipment) resulting in vessel-to-vessel collision, exclusion from fishing grounds, damage to or loss of fishing equipment and loss of commercial fish catches.		
Extent of risks	Highly localised (immediately around vessels).		
Duration of risks	Short-term (minutes for a third-party vessel detour) to long-term (vessel collision).		
Level of certainty of risks	HIGH – the impacts associated with vessel collisions are well known.		
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.		
Impact Consequence (inherent)			
Risk	Likelihood	Consequence	Risk rating
Displacement	Almost certain	Minor	Medium
Interference	Possible	Moderate	Medium
Environmental Controls and Performance Measurement			
EPO	EPS	Measurement criteria	
No incidents or complaints of spatial conflict with third-	Beach has undertaken thorough pre-activity consultation with fishing stakeholders to ensure that commercial fishers are aware of the activity, timing and safety exclusion zone requirements.	Consultation records verify that safety exclusion requirements were communicated to commercial fishing stakeholders.	

party vessels or fishing equipment.	The AHO will be notified of the activity at least a month prior to commencement to enable the promulgation of Notice to Mariners and AusCoast navigational warnings.	Notice to Mariners is available, including construction vessel details, location and timing.
		AusCoast warnings list the vessel locations.
	The CSV is readily identifiable to third-party vessels.	Visual inspection (and associated completed checklists) verify that the anti-collision monitoring equipment (e.g., 24-hour radar watch, GMDSS and Automatic Identification System [AIS]) is functional and in use.
	Visual and radar watch is maintained on the bridge of the construction vessel at all times. The Vessel Master and deck officers have a valid SCTW certificate in accordance with AMSA Marine Order 70 (seafarer certification) (or equivalent) to operate radio equipment to warn of potential third party spatial conflicts (e.g., International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers [STCW95], GMDSS proficiency).	Appropriate qualifications are available.
	The Vessel Master issues warnings (e.g., radio warning, flares, lights/horns) to third-party vessels approaching the PSZ in order to prevent a collision.	Radio operations communications log verifies that warnings to third-party vessels approaching the PSZ have been issued when necessary.
Vessel-to-vessel collisions are managed in accordance with vessel-specific emergency procedures.	The Vessel Master will sound the general alarm, manoeuvre the vessel to minimise the effects of the collision and implement all other measures as outlined in the vessel or structure collision procedure (or equivalent).	Incident report verifies that the relevant safety procedure was implemented.
	Vessel collisions will be reported to AMSA if that collision has or is likely to affect the safety, operation or seaworthiness of the vessel or involves serious injury to personnel.	Incident report verifies that AMSA was notified of a vessel collision.

Impact Consequence (residual)			
Risk	Likelihood	Consequence	Risk rating
Displacement	Unlikely	Minor	Low
Interference	Highly unlikely	Moderate	Low

Demonstration of ALARP

A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by relevant persons about displacement or interference with third-party vessels for this activity.	
Legislative context	The EPS outlined in this table align with the requirements of: OPGGS Act 2006 (Cth).	

	Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others). *Navigation Act* 2012 (Cth). Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions). AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). AMSA Marine Order Part 30 (Prevention of Collisions).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore physical presence in Section 4.3.1 of the guidelines, which include: Develop exclusion zones in consultation with key stakeholders, including local fishing communities; raise awareness of exclusion zones with all stakeholders. Issue a 'Notice to Mariners' through the relevant government agencies, detailing the area of operations. Ensure all vessels adhere to International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels. Optimise vessel use to ensure the number of vessels required and length of time that vessels are on site is as low as practicable.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	• There are no guidelines specifically regarding physical presence for offshore activities.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS listed in this table meet these guidelines with regard to: Ship Collision (item 120). To avoid collisions with third-party vessels, offshore facilities should be equipped with navigational aids that meet national and international requirements.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the impact on other marine resource users to ALARP and to an acceptable level. To reduce risks to public safety to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	This hazard does not intersect nearby AMPs.
	Wetlands of international importance	This hazard will not intersect any Ramsar wetlands.
	TECs	This hazard will not intersect any TECs.
	NIWs	This hazard will not intersect any NIWs.
	Nationally threatened and migratory species	This hazard does not have any impacts on threatened or migratory species.
	Other matters	

	State marine parks	This hazard will not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
Continuous bridge monitoring

Record Keeping	
Stakeholder consultation communication records.	Bridge communication logs.
Notice to Mariners.	Crew qualifications.
AusCoast warnings.	Incident reports.

7.12 RISK - Accidental Discharge of Hazardous and Non-hazardous Materials and Waste

7.12.1 Hazard

The handling and storage of materials and waste on board a vessel has the potential to result in accidental overboard disposal of hazardous and non-hazardous materials and wastes, creating marine debris and pollution.

Small quantities of hazardous and non-hazardous materials are used in routine operations and maintenance and waste is created, and then handled and stored on the CSV. In the normal course of operations, solid and liquid hazardous and non-hazardous materials and wastes will be stored until it is disposed of via port facilities for disposal at licensed onshore facilities. However, accidental releases to sea are a possibility, especially in rough ocean conditions when items may roll off or be blown off the deck.

The following non-hazardous materials and wastes will be disposed of to shore, but have the potential to be accidentally dropped or disposed overboard due to overfull bins, crane operator error or improper storage:

- Paper and cardboard;
- Wooden pallets;
- Scrap steel, metal and aluminium;
- Glass;
- Foam (e.g., ear plugs); and
- Plastics (e.g., hard hats).

The following hazardous materials (defined as a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal, and as outlined in Annex III to the Basel Convention, may be toxic, flammable, explosive and poisonous) may be used and waste generated through the use of consumable products and will be disposed to shore, but may be accidentally dropped or disposed overboard:

- Hydrocarbons, hydraulic oils/fluids and lubricants;
- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters);
- Batteries, empty paint cans, aerosol cans and fluorescent tubes;
- Contaminated personal protective equipment (PPE);

- Laboratory wastes (such as acids and solvents); and
- Larger dropped objects (that may be hazardous or non-hazardous) may be lost to the sea through accidents (e.g., crane operations) include:
  - Sea containers;
  - Towed equipment;
  - ROV; and
  - Entire skip bins/crates.

7.12.2 Known and potential environmental impacts

The potential impacts of the release of hazardous and non-hazardous materials and waste to the ocean are:

- Marine pollution (temporary and localised reduction in water quality)
- Injury and entanglement of individual animals (such as seabirds and pinnipeds);
- Toxicity to marine fauna through ingestion or absorption;
- Localised (and normally temporary) smothering or contamination of benthic habitats; and
- Navigation hazards to transiting vessels.

7.12.3 EMBA

The EMBA for the accidental disposal of hazardous and non-hazardous materials and waste is likely to extend for kilometres from the release site (as buoyant waste drifts with currents) or localised for non-buoyant items that sink to the seabed.

Receptors susceptible to waste that may occur within this EMBA, either as residents or migrants, are:

- Benthic fauna;
- Benthic habitat (sand and reef substrates);
- Pelagic fish;
- Cetaceans;
- Turtles
- Pinnipeds; and
- Avifauna.

The EPBC Act-listed species documented as being negatively impacted by the ingestion of, or entanglement in, harmful marine debris (and known to occur in the EMBA) are (according to DoEE, 2018):

- The three turtle species (loggerhead, green and leatherback);
- Eight albatross species and three petrel species;
- Other birds (flesh-footed shearwater, southern fairy prion);
- Australian fur-seal;
- Indian Ocean bottlenose dolphin; and

- The southern right, pygmy blue, humpback, sei, pygmy right and killer whales.

7.12.4 Evaluation of Environmental Risks

7.12.4.1 Non-hazardous Materials and Waste

If discharged overboard, non-hazardous materials and wastes can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by turtles, seabirds and fish). For example, the TSSC (2015b) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species).

Marine fauna including cetaceans, turtles and seabirds can be severely injured or die from entanglement in marine debris, causing restricted mobility, starvation, infection, amputation, drowning and smothering (DoEE, 2018). Seabirds entangled in plastic packing straps or other marine debris may lose their ability to move quickly through the water, reducing their ability to catch prey and avoid predators, or they may suffer constricted circulation, leading to asphyxiation and death. In marine mammals and turtles, this debris may lead to infection or the amputation of flippers, tails or flukes (DoEE, 2018). Plastics have been implicated in the deaths of a number of marine species including marine mammals and turtles, due to ingestion.

If dropped objects such as bins are not retrievable (e.g., by crane), these items may permanently smother very small areas of seabed, resulting in the loss of benthic habitat. However, as with most subsea infrastructure, the items themselves are likely to become colonised by benthic fauna over time (e.g., sponges) and become a focal area for sea life, so the net environmental impact is likely to be neutral. Seabed substrates can rapidly recover from temporary and localised impacts. The benthic habitats in the activity area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance.

7.12.4.2 Hazardous Materials and Waste

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical or hydrocarbon spills can (depending on the volume released) impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the contaminant with the surrounding seawater. In an open ocean environment such as Bass Strait, it is expected that any minor release would be rapidly diluted and dispersed, and thus any impacts would be temporary and localised.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which could result in the adjacent substrate becoming toxic and unsuitable for colonisation by benthic fauna. The benthic habitats of the activity area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance.

7.12.5 Risk Assessment

Table 7-15 presents the risk assessment for the accidental disposal of hazardous and non-hazardous materials and waste.

Table 7-15: Risk assessment for the unplanned discharge of solid or hazardous waste to the marine environment

Summary		
Summary of risk	Marine pollution (litter and a temporary and localised reduction in water quality), injury and entanglement of individual animals (such as seabirds and seals) and smothering or pollution of benthic habitats.	
Extent of risks	Non-buoyant waste may sink to the seabed near where it was lost. Buoyant waste may float long distances with ocean currents and winds.	
Duration of risks	Short-term to long-term, depending on the type of waste and location.	
Level of certainty of risk	HIGH – the effects of inappropriate waste discharges are well known.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Likelihood	Consequence	Risk rating
Possible	Moderate	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
No unplanned release of hazardous or non-hazardous solid wastes or materials.	A MARPOL Annex V-compliant Garbage Management Plan (GMP) is in place for the CSV that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	A GMP is in place, readily available on board and kept current.
	Waste is stored, handled and disposed of in accordance with the GMP. This includes measures including: No discharge of general operational or maintenance wastes or plastics or plastic products of any kind. Waste containers are covered with secure lids to prevent solid wastes from blowing overboard. All solid wastes are stored in designated areas before being sent ashore for recycling, disposal or treatment. Any liquid waste storage on deck must have at least one barrier to minimise the risk of spills to deck entering the ocean. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place. Correct segregation of solid and hazardous wastes.	GMP is available and current. Inspections verify that waste is stored and handled according to its waste classification. Inspections verify that waste receptacles are properly located, sized, labelled, covered and secured for the waste they hold. A licensed shore-based waste contract is in place for the management of onshore waste transport and disposal.
	Vessel crews and visitors are inducted into waste management procedures to ensure they understand how to implement the GMP.	Induction and attendance records verify that all crew members are inducted.
	Waste types and volumes are tracked and logged.	Waste tracker is available and current.
	Solid waste that is accidentally discharged overboard is recovered if reasonably practicable.	Incident records are available to verify that credible and realistic attempts to retrieve the materials lost overboard were made.
Avoid objects being dropped overboard	Large bulky items are securely fastened to or stored on the deck to prevent loss to sea.	A completed pre-departure inspection checklist verifies that bulky goods are securely sea-fastened.

	The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects (e.g., vessel-to-vessel transfers).	Completed handling and transfer procedure checklist, Permit to Work (PTW) and/or risk assessments verify that the procedure is implemented prior to each transfer.
	The crane operators are trained to be competent in the handling and transfer procedure to prevent dropped objects.	Training records verify that crane operators are trained in the loading and unloading procedure.
	The vessel PMS is implemented to ensure that lifting equipment remains in certification and fit for use at all times to minimise the risk of dropped objects.	PMS records verify that lifting equipment is maintained to schedule and in accordance with OEM requirements.
	Visual inspection of lifting gear is undertaken every quarter by a qualified competent person (e.g., maritime officer) and lifting gear is tested regularly in line with the vessel PMS.	Inspection of PMS records and Lifting Register verifies that inspections and testing have been conducted to schedule.
Dropped and/or snagged objects are recovered where safe to do so.	Qualified and experienced divers are engaged to recover dropped or snagged equipment if they represent a significant environmental or navigation hazard and cannot be easily recovered by other means.	Deployment/retrieval vessel POB lists qualified divers for the duration of operations.
		Diver CVs confirm their qualifications and experience are suitable for this task.
Personnel are competent in spill response and have appropriate resources to respond to a spill.	The CSV crew is competent in spill response and has appropriate response resources in order to prevent or minimise hydrocarbon or chemical spills discharging overboard.	Training records verify that vessel crews receive spill response training.
	Fully stocked SMPEP response kits and scupper plugs or equivalent drainage control measures are readily available and used in the event of a spill to deck to prevent or minimise discharge overboard.	Site inspections (and associated completed checklists) verify that fully stocked spill response kits and scupper plugs (or equivalent) are available on deck in high-risk locations.
		Review of incident reports indicate that the spills of hydrocarbons or chemicals to deck are cleaned up.
Chemicals and hydrocarbons are stored and transferred in a manner that prevents bulk release.	All hydrocarbons and chemicals are stored within secure receptacles within bunded areas or dedicated chemical lockers that drain to bilge tanks.	Visual inspection verifies that hydrocarbons and chemicals are stored within secure receptacles within bunded areas or dedicated chemical lockers that drain to bilge tanks.
	The PMS is implemented to ensure the integrity of chemical and hydrocarbon storage areas and transfer systems are maintained in good order.	PMS records verify that chemical and hydrocarbon storage areas and transfer systems (e.g., bunds, tanks, pumps and hydraulic hoses) are maintained to schedule and in accordance with OEM requirements.
	Where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.	Visual inspection verifies that where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.

	Crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the vessel contractor lifting and loading procedure, or equivalent, and under a Permit to Work (PTW).		PTW records verify that crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the procedure.
Risk Assessment (residual)			
Consequence	Likelihood		Risk rating
Moderate	Highly unlikely		Low
Demonstration of ALARP			
A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.			
Demonstration of Acceptability			
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
	• Management system compliance	• Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by relevant persons about accidental waste releases for this activity.		
Legislative context	The performance standards outlined in this EP align with the requirements of: *Navigation Act* 2012 (Cth): Chapter 4 (Prevention of Pollution). Marine Orders Part 47. Marine Orders Part 94 (Marine pollution prevention – packaged harmful substances). Marine Orders Part 95 (Marine pollution prevention – garbage). *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): Part III (Prevention of pollution by noxious substances). Part IIIA (Prevention of pollution by packaged harmful substances). Part IIIC (Prevention of pollution by garbage).		
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.		
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity are in line with the management measures listed for hazardous waste and non-hazardous waste discharges in Sections 4.6.2 and 4.6.3 of the guidelines, which include: Segregating hazardous and non-hazardous wastes prior to disposal. Managing hazardous waste in accordance with their SDS and tracking it to final destination. Not deliberately discharging waste overboard.	
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: Risk management for handling and storage of chemicals (item 19). The BAT are met for the activity with regard to implementing chemical transfer procedures and ensuring chemicals are stored in separate, labelled containers.	
	Environmental, Health and Safety Guidelines for Offshore	Guidelines met with regard to: Waste management (items 46). Materials should be segregated offshore and shipped to shore for reuse,	

	Oil and Gas Development (World Bank Group, 2015)	recycling or disposal. A waste management plan should be developed and contain a mechanism allowing waste consignments to be tracked. Hazardous materials management (item 72). Principles relate to the selection of chemicals with the lowest environmental and health risks.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the risk of any unplanned release of material into the marine environment to as low as reasonably practical and to an acceptable level.
	Waste management-specific	
	Guidelines for the Development of GMPs (IMO, 2012)	The GMP is developed in accordance with these guidelines.
	International Dangerous Goods Maritime Code (IMO, 2014)	The storage and handling of dangerous goods on the CSV is managed in accordance with this code.
Environmental context	MNES	
	AMPs	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect nearby AMPs. The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies marine debris as a threat to the AMP network. The EPS listed in this table aim to minimise the generation of marine debris and are aligned with the strategies outlined in the plan.
	Wetlands of international importance	The unplanned discharge of solid or hazardous waste is highly unlikely to reach Ramsar wetlands.
	TECs	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any TECs.
	NIWs	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any NIWs.
	Nationally threatened and migratory species	The unplanned discharge of solid or hazardous waste is highly unlikely to have any impacts on threated or migratory species.
	Other matters	
	State marine parks	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The risks posed by this hazard do not impact this action. The Conservation Management Plan for the Blue Whale (DoE, 2015d) identify marine debris as a threat, but there are no conservation management actions to counter this. The EPS listed in this table aim to minimise the generation of marine debris. The conservation advice for hooded plovers (DoE, 2014) identifies ingestion of marine debris as a threat that requires reducing inshore debris. The EPS listed in this table aim to minimise the generation of marine debris.

		The EPS listed in this table meet objective one of the Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's coasts and oceans (DoEE, 2018), which is to contribute to the long-term prevention of the incidence of harmful marine debris.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
Waste tracking.

Record Keeping	
Vessel contractor pre-qualification report/s.	Inspection records/checklists.
GMP.	Shore-based waste contract.
Garbage Record Book.	Incident reports.
Crew induction and attendance records.	

7.13 RISK – Vessel Collision or Entanglement with Megafauna

7.13.1 Hazard

The movement and presence of the CSV in the activity area, together with the presence of subsea production equipment during the installation process, has the potential to result in collision or entanglement with megafauna (cetaceans and pinnipeds).

7.13.2 Known and potential environmental impacts

The potential impacts of vessel strike with megafauna are:

- Injury; and
- Death.

7.13.3 EMBA

The EMBA for megafauna vessel strike or entanglement with installation equipment is the immediate area around the CSV and production equipment. Receptors most at risk within this EMBA are:

- Cetaceans (whales and dolphins);
- Turtles; and
- Pinnipeds (fur-seals).

7.13.4 Evaluation of Environmental Risks

Cetaceans and pinnipeds are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly 'bow ride' with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al.*, 1995).

Peel et al (2016) reviewed vessel strike data (2000-2015) for marine species in Australian waters and identified the following:

- Whales including the humpback, pygmy blue, Antarctic blue, southern right, dwarf minke, Antarctic minke, fin, bryde's, pygmy right, sperm, pygmy sperm and pilot species were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction followed by the southern right whale, and these species may migrate through the waters of the activity area (see Section 5.5.9).
- Dolphins including the Australian humpback, common bottlenose, indo-pacific bottlenose and Risso's dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. A number of these species may reside in or pass through the waters of the activity area (see Section 5.5.9).
- There were no vessel interaction reports during the period for either the Australian or New Zealand fur-seal. There have been incidents of seals being injured by boat propellers, however all indications are rather than 'boat strike' these can be attributed to be the seal interacting/playing with a boat, with a number of experts indicating the incidence of boat strike for seals is very low.
- All turtle species present in Australian waters are identified as interacting with vessels. The green and loggerhead species exhibited the highest incident of interaction. The presence of turtles in the activity area and EMBA is considered remote.

Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde's whale in Bass Strait in 1992), though the data indicates this is more likely to be associated with container ships and fast ferries (WDCS, 2006). Some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (WDCS, 2006). The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with an animal (species not defined) (NMSC, 2010).

The DoE (Commonwealth of Australia, 2015b) reports that there were two blue whale strandings in the Bonney Upwelling (western Victoria) with suspected ship strike injuries visible. When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise 'footprint' will alert cetaceans to its presence and thus elicit avoidance. Laist et al (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots. When the CSV is operating within the activity area, it will be moving very slowly or will be stationery, so the risk associated with fast moving vessels is eliminated for this activity.

The DSEWPC (2012a) notes that whale entanglement in nets and lines often causes physical damage to skin and blubber. These wounds can then expose the animal to infection. Entanglement can also result in amputation (e.g., of a flipper or tail fluke), and death over a prolonged period. The Commonwealth of Australia (2015b) states that entanglement (in the context of fishing nets, lines or ropes) has the potential to cause physical injury that can result in loss of reproductive fitness, and mortality of individuals from drowning, impaired foraging and associated starvation, or infection or physical trauma. There is an almost negligible risk of this occurring to megafauna with tethered ROVs as the tethers are likely to break under the weight of entanglement. The Australian and New Zealand fur-seals are highly agile species that haul themselves onto rocks and platform jackets. As such, it is likely that they will be able to avoid equipment tethered to the CSV and are unlikely to become entangled within such equipment.

The CSV will be largely stationary while installing the subsea production equipment, thus minimising the risk of injury to megafauna. Combined with the low likelihood of presence of SRW, humpback whales and blue whales in and around the activity area during the proposed activity period, and the lack of a defined migration route for pygmy blue whales in western Bass Strait, makes it even more unlikely that vessel strike or equipment entanglement with threatened whale species will occur.

7.13.5 Risk Assessment

Table 7-16 presents the risk assessment for vessel collision with megafauna.

Table 7-16: Risk assessment for vessel collision with megafauna

Summary			
Summary of risks	Injury or death of cetaceans and/or pinnipeds.		
Extent of risks	Localised (limited to individuals coming into contact with the vessel or equipment).		
Duration of risks	Temporary (if individual animal dies or has a minor injury) to long-term (if there is a serious injury).		
Level of certainty of risk	HIGH – injury may result in the reduced ability to swim and forage. Serious injury may result in death.		
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.		
Risk Assessment (inherent)			
Risk	Likelihood	Consequence	Risk rating
Individual animal	Unlikely	Moderate	Medium
Population level	Unlikely	Minor	Low
Environmental Controls and Performance Measurement			
EPO	EPS		Measurement criteria
No injury or death of megafauna as a result of vessel strike or entanglement with deployed equipment.	Through constant bridge watch, the CSV complies with the *Australian National Guidelines for Whale and Dolphin Watching for Vessels* (DoEE, 2017b) when working within the activity area. This means: Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone. No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod/group. Do not encourage bow riding. If animals are bow riding, do not change course or speed suddenly. If there is a need to stop, reduce speed gradually.		Daily operations reports note when cetaceans and pinnipeds were sighted and what actions were taken to avoid collision or entanglement.
	Vessel crew has completed an environmental induction covering the above-listed requirements for vessel and megafauna interactions.		Induction and attendance records verify that all crews have completed an environmental induction.
Vessel strike or entanglement is reported to regulatory authorities.	Vessel strike causing injury to or death of a cetacean is reported to the DoEE via the online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike) within 72 hours of the incident.		Electronic record of report submittal is available.
			Incident report is available within the OMS.
	Entanglement of megafauna (such as ROV tether or crane cable) is reported to the Whale and Dolphin Emergency Hotline on 1300 136 017 as soon as possible. No attempts to disentangle megafauna should be made by vessel crew.		Incident report verifies contact was made with the Whale and Dolphin Emergency Hotline.
Risk Assessment (residual)			
Risk	Likelihood	Consequence	Risk rating
Individual animal	Highly unlikely	Moderate	Low
Population level	Highly unlikely	Minor	Low

Demonstration of ALARP		
A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	There has been no concern expressed by relevant persons about collisions with megafauna for this activity.	
Legislative context	The performance standards outlined in this EP align with the requirements of: *EPBC Act* 1999 (Cth): Section 199 (failing to notify taking of listed species or listed ecological community). EPBC Regulations 2000 (Cth): Part 8 (Interacting with cetaceans and whale watching). AMSA Marine Notice 2016/15 – Minimising the risk of collisions with cetaceans.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity are in line with the management measures listed for collision with marine fauna in Section 4.7.5 of the guidelines: Monitoring for the presence and movement of large cetaceans and pinnipeds so that avoidance can be taken when marine fauna is observed to be on a collision course with vessels.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to minimising the risk of collisions with megafauna.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines regarding minimising the risk of vessel strike or entanglement with megafauna.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the risks to the abundance, diversity, geographical spread and productivity of marine species to ALARP and to an acceptable level.
	Megafauna collision-specific	
	The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017b)	The EPS listed in this table are aligned with the requirements of these guidelines.
	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017c).	The EPS listed in this table are aligned with objective 3 of this strategy, which is to reduce the likelihood and severity of megafauna vessel collisions.
Environmental context	MNES	

	AMPs	The risk of collisions with megafauna does not have any effect on nearby AMPs.
	Wetlands of international importance	The risk of collisions with megafauna will not have any effect on Ramsar wetlands.
	TECs	The risk of collisions with megafauna will not have any effect on TECs.
	NIWs	The risk of collisions with megafauna will not have any effect on NIWs.
	Nationally threatened and migratory species	The low speed of the CSV, along with the temporary nature of the activity, makes it unlikely that vessel strike or entanglement with megafauna will occur. If vessel strike or entanglement does occur to individual animals, this will not be a significant impact in the context of species' populations.
	Other matters	
	State marine parks	The risk of collisions with megafauna will not have any effect on state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Vessel collisions (and/or entanglements) are listed as a threat to cetaceans in the: Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012a); Conservation Management Plan for the Blue Whale (DoE, 2015d); Conservation advice for the sei whale (TSSC, 2015c); Conservation advice for the fin whale (TSSC, 2015d). The EPS listed in this table aim to minimise the risk of vessel strike and entanglement with megafauna and do not breach the management actions of the above-listed whale conservation plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
Opportunistic megafauna sightings by vessel crews.

Record Keeping
Vessel crew induction presentation and attendance records. Megafauna sighting records. Incident reports.

7.14 RISK – Introduction and Establishment of Invasive Marine Species

7.14.1 Hazards

The DAWR (2018) defines marine pests (referred to in this EP as invasive marine species, IMS) as:

> *Non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment.*

The following activities have the potential to result in the introduction of IMS in the activity area:

- Discharge of vessel ballast water containing foreign species; and
- Translocation of foreign species through biofouling on vessel hulls, niches (e.g., thruster tunnels, sea chests) or in-water equipment (e.g., ROV).

The CSV may ballast and de-ballast to improve stability, even out vessel stresses and adjust vessel draft, list and trim, with regard to the weight of equipment on board at any one time.

Biofouling is the accumulation of aquatic microorganisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWR, 2015).

The DAWR estimates that ballast water is responsible for 30% of all marine pest incursions into Australian waters (DAWR, 2018). The DAWR declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (AQIS, 2011), while DAWR (2018) notes that the movement of vessels and marine infrastructure is the primary pathway for the introduction of IMS.

7.14.2 Known and potential environmental impacts

The potential impacts of IMS introduction (assuming their survival, colonisation and spread) include:

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Depletion of commercial fish stocks (and associated socio-economic effects); and
- Changes to conservation values of protected areas.

7.14.3 EMBA

The EMBA for IMS introduction is anywhere within the activity area, though if IMS survive the introduction and go on to colonise and spread, this EMBA could extend to large parts of Bass Strait.

Receptors most at risk within this EMBA, either as residents or migrants, are:

- Benthic fauna (because of their limited ability to move to other suitable areas);
- Benthic habitat; and
- Pelagic fish.

7.14.4 Evaluation of Environmental Risks

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., activity 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.

If successful invasion takes place, the IMS is likely to have little or no natural competition or predation, thus potentially outcompeting native species for food or space, preying on native species or changing the nature of the environment. It is estimated that approximately one in six introduced marine species becomes pests (AMSA, n.d).

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion (AMSA, n.d). For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries. Similarly, the ability of the New Zealand screw shell (*Maoricolpus roseus*) to reach densities of thousands of shells per square metre has presented problems for commercial scallop fishers (MESA, 2017). The ABC (2000) reported that the New Zealand screw shell is likely to displace similar related species of screw shells, several of which occupy the same depth range and sediment profile.

Marine pests can also damage marine and industrial infrastructure, such as encrusting jetties and marinas or blocking industrial water intake pipes. By building up on vessel hulls, they can slow the vessels down and increase fuel consumption.

7.14.5 Risk Assessment

Table 7-17 presents the risk assessment for the introduction of IMS.

Table 7-17: Risk assessment for the introduction of IMS

Summary		
Summary of risks	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 areas.	
Extent of risk	Localised (isolated locations if there is no spread) to widespread (if colonisation and spread occurs).	
Duration of risk	Short-term (IMS is detected and eradicated, or IMS does not survive long enough to colonise and spread) to long-term (IMS colonises and spreads).	
Level of certainty of risk	HIGH – the impacts associated with IMS introduction are well known and the vectors of introduction are known. Regulatory guidelines controlling these vectors have been established.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Likelihood	Consequence	Risk rating
Unlikely	Major	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Vessels used to undertake the activity do not introduce IMS.	A pre-qualification is undertaken for the CSV against Beach's IMS Management Plan ((IMSMP) S4000AH719916) prior to charter to ensure biofouling and ballast water controls meet these EP requirements. The requirements of the IMSMP are outlined herein.	Vessel contractor pre-qualification audit report verifies the vessel meets the requirements outlined in the IMSMP.
Biofouling		
Vessels do not introduce IMS to the activity area	The CSV is managed in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (AQIS, 2009) and the to ensure they present a low biofouling risk. This means:	Biofouling assessment report prior to mobilising to site confirms acceptability to enter the activity area

	Biofouling risk is assessed. Conducting in-water inspection by divers or inspection in drydock if deemed necessary (based on risk assessment). Cleaning of hull and internal seawater systems, if deemed necessary. Anti-fouling coating status taken into account, with antifouling renewal undertaken if deemed necessary.	
	Vessels >400 gross tonnes carry a current International Anti-fouling System (IAFS) Certificate that is complaint with Marine Order Part 98 (Anti-fouling Systems).	IAFS Certificate is available and current.
	The CSV is managed in accordance with the *Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species* (IMO, 2011), which involves ensuring that vessels: Maintain a Biofouling Management Plan; Maintain a Biofouling Record Book; Install and maintain an anti-fouling system; Undertake in-water inspections (and in-water hull cleaning, if appropriate); and Instruct crews on the application of biofouling management procedures.	Vessel contractor Biofouling Management Plan and Biofouling Record Book are available and current.
	An IMS risk assessment is undertaken based on the following: Inspecting the IAFS certificate to ensure currency. Reviewing recent vessel inspection/audit reports to ensure that the risk of IMS introduction is low. Reviewing recent ports of call to determine the IMS risk of those ports. Determining the need for in-water cleaning and/or re-application of anti-fouling paint if neither has been done recently in line with anti-fouling and in-water cleaning guidelines (DoA/DoE, 2015). Implementing the biofouling guidance provided in Part 5 of the Offshore Installation Biosecurity Guideline (DAWR, 2019, v1.3).	IMS risk assessment document verifies that the biofouling risk evaluation took place and that the IMS risk is 'low.'
Immersible equipment does not introduce IMS to the activity area.	Immersible equipment is cleaned (e.g., biofouling is removed from airguns and streamers) prior to initial use in the activity area.	Records are available to verify that immersible equipment was cleaned prior to use.
Ballast water		
Internationally-sourced vessels discharge only low risk ballast water.	The CSV fulfils the requirements of the *Australian Ballast Water Management Requirements* (DAWR, 2020, v8). This includes requirements to: Carry a valid Ballast Water Management Plan (BWMP). Submit a Ballast Water Report (BWR) through the Maritime Arrivals Reporting System (MARS).	BWMP is available and current. BWR (or exemption) is submitted prior to entry to the activity area. A valid BWMC is in place. An up-to-date BWRS is in place.

	If intending to discharge internationally-sourced ballast water, submit BWR through MARS at least 12 hours prior to arrival. If intending to discharge Australian-sourced ballast water, seek a low-risk exemption through MARS. Hold a Ballast Water Management Certificate (BWMC). Ensure all ballast water exchange operations are recorded in a Ballast Water Record System (BWRS).	An ePAR is available and signed off by DAWR.
Vessels only discharge low risk ballast water.	As above, except a BWR is not required for domestic journeys (i.e., when moving between Australian ports and 200 nm of the coastline). Note: ballast water management is not required between Australian ports if: Ballast water is taken up and discharged in the same place. Potable water is used as ballast. Ballast water was taken up on the high seas only. The vessel receives a risk-based exemption from ballast water management.	As above, except for the BWR.
Reporting		
Known or suspected non-compliance with biosecurity measures are reported to regulatory agencies.	Non-compliant discharges of domestic ballast water are to be reported to the DAWR immediately.	Incident report notes that contact was made with the DAWR regarding non-compliant ballast water discharges.

Risk Assessment (residual)		
Likelihood	Consequence	Risk rating
Highly unlikely	Major	Medium

Demonstration of ALARP

A 'medium' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved relevant persons known to have concerns with the activity. There has been no concern expressed by stakeholders about introduction and establishment of IMS for this activity.	
Legislative context	The performance standards outlined in this EP align with the requirements of: *Biosecurity Act* 2015 (Cth): Chapter 4 (Managing biosecurity risk). Chapter 5, Part 3 (Management of discharge of ballast water). *Protection of the Sea (Harmful Anti-fouling Systems) Act* 2006 (Cth): Part 2 (Application or use of harmful anti-fouling systems).	

	Part 3 (Anti-fouling certificates and anti-fouling declarations). Marine Order 98 (Marine pollution – anti-fouling systems).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity are in line with the management measures listed for the introduction of IMS in Section 4.7.6 of the guidelines: Developing an IMS Management Plan (where applicable). Complying with the International Convention on the Control of Harmful Anti-fouling Systems on Ships. Ensuring vessels of appropriate class have IFAS certificates. Ensuring compliance with local regulatory guidelines.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to minimising the risk of introducing IMS.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines regarding preventing the introduction of IMS.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the risk of introduction of marine pests to ALARP and to an acceptable level. To reduce the impacts to benthic communities to ALARP and to an acceptable level.
	IMS-specific	
	Offshore Installations - Quarantine Guide (DAWR, 2019, v1.3)	The EPS in this table reflect the guidance regarding ballast water and biofouling management in the DAWR guide.
	Australian Ballast Water Management Requirements (DAWR, 2020, v8)	The EPS in this table reflect the guidance regarding ballast water management in the DAWR guide.
	Anti-Fouling and In-Water Cleaning Guidelines (DoA/DoE, 2015).	The EPS in this table reflect the general guidance regarding managing fouling in the DoA/DoE guidelines, which have since been updated in the aforementioned DAWR (2019) quarantine guide.
	Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species (IMO, 2011)	The EPS in this table reflect the guidance regarding minimising the transfer of IMS from biofouling.
	National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (DAFF, 2009)	The EPS in this table reflect the guidance regarding biofouling management in the DAFF guide.
Environmental context	MNES	

	AMPs	The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies IMS and diseases translocated by shipping, fishing vessels and other vessels as a threat to the AMP network. The implementation of the EPS listed here make it unlikely that IMS will be introduced to the activity area and spread to nearby AMPs.
	Wetlands of international importance	The risk of introducing IMS is highly unlikely to affect Ramsar wetlands.
	TECs	The risk of introducing IMS is highly unlikely to affect TECs.
	NIWs	The risk of introducing IMS is highly unlikely to affect NIWs.
	Nationally threatened and migratory species	The threatened and migratory species within the EMBA are all highly mobile species. There are no EPBC Act-listed benthic species listed in the activity area; these are generally more susceptible to the effects of IMS than mobile fauna.
	Other matters	
	State marine parks	This hazard does not intersect any state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The National Strategic Plan for Marine Pest Biosecurity (2018-2023) (DAWR, 2018) has five objectives. The EPS listed in this table are aligned with the plan's objective to minimise the risk of marine pest introductions, establishment and spread (noting that the other four objectives do not apply to the activity).
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
	Is there a threat of serious or irreversible environmental damage?	Possibly. But the EPS aim to avoid this.
	Is there scientific uncertainty as to the environmental damage?	Yes. Individual species fill different ecological niches and understanding how one or more species are likely to behave outside their native habitat is generally unknown until it occurs.

Environmental Monitoring
None required.

Record Keeping	
Vessel contractor pre-qualification reports.	BWMC.
Biofouling risk assessment.	BWRS.
Ballast water risk assessments.	IAFS Certificates.
BWMP.	DAWR-signed ePARs.
BWR.	

7.15 RISK – Damage to Subsea Petroleum Infrastructure

7.15.1 Hazard

There is the potential for damage to existing subsea petroleum infrastructure from the accidental loss of an object from the CSV during the subsea installation activities. 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.

According to the Dropped Object Study undertaken by Add Energy (2019) for the Otway Offshore Phase 4 drilling campaign, the 11” flexible flowline is particularly vulnerable to the impact from a dropped object, with flowline rupture likely to occur dependant on the dropped object load rating. Flexible flowlines have much lower impact resistance compared to rigid flowlines (such as carbon steel flowlines). Other vulnerable hydrocarbon-containing subsea equipment include the rigid tie-in spools and suspended piping in the coolers. The infield umbilicals are similarly vulnerable but do not normally contain hydrocarbons.

7.15.2 Known and potential environmental impacts

The potential environmental impacts of dropped objects on existing subsea petroleum infrastructure include:

- Physical damage to a wellhead, XT, production spools, umbilicals and SDU, heat exchangers, EFLs and HFLs;
- Rupturing hydrocarbon-containing subsea infrastructure leading to hydrocarbon release; and
- Highly localised displacement of seabed habitat.

7.15.3 EMBA

The EMBA for damage to existing subsea petroleum infrastructure from dropped objects is limited to the immediate vicinity of the subsea infrastructure.

7.15.4 Evaluation of Environmental Risk

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 (see Section 7.2). 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.

A dropped object study (i.e., Otway Offshore Phase 4 – Ocean Onyx SIMOPS Dropped Object Study, BEA001-REP-003) was conducted for the Geographe subsea facilities to determine the dropped object events that can cause loss of containment, the consequence of loss of containment and the frequency these events. Impact energy of objects striking the seabed has been calculated using the method detailed in DNV-RP-F107. The calculation considers various factors that affect the dropped object as it falls through the water. These factors include the object mass, volume, drag coefficient, projected area.

The subsea infrastructure is designed to withstand a dropped object impact energy of 10kJ with additional protection for structures such as the coolers (refer to Otway Offshore Pipeline Safety Case (CDN/ID 18986424). For this study, the energy absorption capacity of all subsea equipment was considered to be 10kJ.

The consequences of a dropped object impacting subsea equipment depend on the impact energy of the object and the energy absorption characteristics of the subsea equipment. Should the dropped object impact energy exceed the energy absorption capacity of the subsea equipment, damage and/or rupture of the subsea equipment may occur (Add Energy, 2019).

The infield umbilical does not normally contain hydrocarbons but includes a pressure equalisation line connected to the pipeline system. The umbilicals and associated equipment contain methanol, water-based hydraulic fluid and MEG, which present negligible environmental risk if released due to their low toxicity. Methanol and MEG are miscible in water and readily dilute in seawater when released. The hydraulic fluid is glycol-based and would similarly dilute in seawater (Add Energy, 2019).

There is no risk of a well blowout within the activity area because the wells will be shut-in during the activity. As such, a catastrophic loss of hydrocarbons will not occur, even if there is damage to a XT or wellhead. For this reason, a formal risk assessment has not been undertaken to determine loss of containment from an existing wellhead and modelling the release of gas and associated liquids to the marine environment has not been undertaken. Because the wells will be shut-in at the time of the activity and the existing flowlines and spools will be purged prior to the activity.

7.15.5 Risk Assessment

Table 7-18 presents the risk assessment for the potential damage of existing subsea infrastructure due to dropped objects.

Table 7-18: Risk assessment for damage of subsea infrastructure due to dropped objects

Summary		
Summary of risks	Damage to existing subsea infrastructure from dropped objects during subsea installation and commissioning activities.	
Extent of risks	Highly localised – immediate vicinity or surrounding existing subsea infrastructure.	
Duration of risks	Short-term – duration of activity.	
Level of certainty of risks	HIGH – the impacts associated with dropped objects are well known.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Likelihood	Consequence	Risk rating
Possible	Moderate	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Avoid loss of hydrocarbons from subsea equipment.	The activity will only commence once production from Geographe-2 is shut-in as per completed Permit to Work.	Permit to Work verifies that gas flow is shut-in prior to and for the duration of the activity.
Avoid damage to existing subsea infrastructure.	CSV will hold position using DP rather than anchoring.	Daily operations reports verify the use of DP only.
	The CSV shall stand-off at a safe distance during any outboard lifting operations. Minimum vessel offsets are to be taken as per the DOF Subsea Engineering Basis of Design (calculated in accordance with DNVGL-RP-F107 [C5])	Daily operations reports.
	Simultaneous operations (SIMOPS) shall be in accordance with the Otway Offshore Pipeline Safety Case (CDN/ID 18986424) to prevent damage from dropped objects.	SIMOPS reports verify that SIMOPS procedures were followed.
	Lifting gear is load rated for the working load.	Certificates of lifting gear equipment verify lifting gear is load rated.
	Crane lifting operations will be undertaken by competent personnel.	Training records verify that crane operators are trained in the loading and unloading procedure.
	All lifting equipment will be certified, regularly inspected (every quarter by a qualified competent person) and lifting gear is maintained as per manufacturer's specification (as per the Otway Offshore Pipeline Safety Case (CDN/ID 18986424).	Inspection of PMS records and Lifting Register verifies that inspections and testing have been conducted to schedule

Large objects dropped overboard will be retrieved, if safe and practicable to do so.	The location of dropped objects left behind at the end of inspection activities (that cannot be retrieved) will be reported to NOPSEMA.	Recordable incident report and transmittal to NOPSEMA is available.
Impact Consequence (residual)		
Likelihood	Consequence	Risk rating
Unlikely	Minor	Low
Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by relevant persons about displacement or interference with third-party vessels for this activity.	
Legislative context	No legislative requirements have been identified.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity are in line with the management measures listed for collision with physical presence in Section 4.3.1 of the guidelines: Consider dynamic positioning to avoid or minimise the need for anchors.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to minimising the risk of dropped objects. •
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS developed for this activity meet these guidelines with regard to: Dropped objects (item 123) - a dedicated dropped objects analysis should be prepared, assessing the risk of loads falling from handling devices and impacting critical areas of the facility or subsea pipelines in the vicinity of the facility.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the impact on other marine resource users to ALARP and to an acceptable level. To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	This risk does not intersect nearby AMPs..

	Wetlands of international importance	This risk will not intersect any Ramsar wetlands.
	TECs	This risk will not intersect any TECs.
	NIWs	This risk will not intersect any NIWs.
	Nationally threatened and migratory species	This risk does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks	This risk will not intersect any state marine parks.
	Species Conservation Advice/Recovery Plans/Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
Continuous DP monitoring.		
Record Keeping		
Permit to work. Daily operations reports. SIMOPS reports Certificates of Lifting gear equipment.	Training records for crane operations or equivalent. PMS records and Lifting Register Otway Offshore Pipeline Safety Case (CDN/ID 18986424). Incident reports.	

7.16 RISK – Loss of Containment – MDO

7.16.1 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 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 and absence of submerged features in the activity area. DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m^3) for offshore vessels caused by collisions or fuel transfers.

7.16.1.1 Characteristics of MDO

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

MDO 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 7-19), 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 7-20 shows the boiling point ranges for the MDO used in the spill modelling.

Table 7-19: Physical characteristics of MDO

Parameter	**Characteristics**
Density (kg/m3)	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 7-20: Boiling point ranges of MDO

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

On release to the marine environment, MDO 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.

7.16.2 Quantitative hydrocarbon spill modelling

Beach commissioned RPS to conduct quantitative spill modelling (Appendix D) for a credible, yet hypothetical, worst-case hydrocarbon release scenario of 603.7 m^3 surface release of MDO over six hours and tracked for 30 days. This scenario represents a loss of inventory from the largest outside 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 point on the activity area closest to shoreline and included 100 simulations for both Summer (November through to March) and Winter (April to October) conditions (i.e. 200

simulations in total). The spill EMBA used for this EP was based on the combined outputs of the Summer and Winter results.

7.16.2.1 Modelled 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 adopted exposure values are based on the exposure values defined in NOPSEMA Bulletin #1 Oil Spill Modelling (NOPSEMA 2019). The hydrocarbon exposure thresholds presented in Table 7-21 are considered appropriate to:

- Predict potential hydrocarbon contact at conservative (low exposure) concentrations and inform the description of the environment (Chapter 5), inform the EPBC Protected Matters Search (Appendix B) 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 Chapter 9).

Table 7-21: Hydrocarbon exposure thresholds

Exposure type	Exposure threshold		
	Low exposure	**Moderate exposure**	**High exposure**
Surface (floating)	1 g/m^2	10 g/m^2	50 g/m^2
Shoreline (accumulated)	10 g/m^2	100 g/m^2	1,000 g/m^2
Dissolved*	10 ppb	50 ppb	400 ppb
Entrained*	10 ppb	-	100 ppb

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

7.16.2.2 Hydrocarbon exposure thresholds used for the impact assessment

As discussed in Section 5.1 and detailed in Table 5-1, the low contact values used to inform the extent of the socio-economic EMBA are useful for establishing scientific monitoring parameters and identifying potential socio-economic impacts (the socio-economic EMBA); however, they may not be at concentrations that are ecologically significant (NOPSEMA, 2019). Therefore, in addition to the socio-economic EMBA, an ecological EMBA has also been derived from the stochastic spill modelling using hydrocarbon thresholds that are identified by NOPSEMA (2019) as having the potential to cause impacts to ecological receptors.

The impact assessment for an MDO spill is based on the moderate exposure levels for floating, shoreline and dissolved hydrocarbons, and the high exposure threshold for entrained hydrocarbons.

7.16.2.3 Modelling Results

A number of BIAs overlap the release location and recorded contact at the impact assessment thresholds. These BIAs are shown in Table 7-22.

Table 7-22: BIAs which overlap the MDO release area

• Antipodean Albatross - Foraging	• Pygmy Blue Whale - Foraging
• Black-browed Albatross - Foraging	• Short-tailed Shearwater - Foraging
• Bullers Albatross - Foraging	• Shy Albatross - Foraging
• Campbell Albatross - Foraging	• Southern Right Whale - Migration
• Common Diving-petrel - Foraging	• Wandering Albatross - Foraging
• Indian Yellow-nosed Albatross - Foraging	• Wedge-tailed Shearwater - Foraging
• Pygmy Blue Whale - Distribution	• White Shark - Distribution

Floating Oil

During summer conditions, surface hydrocarbons were predicted to travel a maximum distance of 24.5 km to the east-southeast at the moderate (10 g/m^2) exposure threshold. During winter, surface hydrocarbons extended to a maximum distance of 19.5 km to the south-southeast from the release location. No AMPs or KEFs were contacted at the moderate threshold (the Apollo AMP had a 4% and 5% probability of contact at the low threshold during summer and winter, respectively; the West Tasmanian Canyons KEF had a 4% and 2% probability of contact at the low threshold during summer and winter, respectively). The BIAs listed in Table 7-22 are all contacted at the high threshold level. No other BIAs were contacted at the moderate threshold.

The zones of potential floating oil are shown in Figure 7-4 (summer) and Figure 7-5 (winter).

Shoreline Accumulation

During summer conditions, King Island recorded a 1% probability of oil accumulation on its shorelines at the moderate (100 g/m^2) exposure threshold, with the maximum length of shoreline affected predicted to be 10.1 km. The maximum volume ashore was predicted to be 27.6 m^3. The shorelines predicted to be contacted above the moderate threshold during winter conditions are shown in Table 7-23. No shorelines were predicted to be contacted at the high threshold.

The maximum potential shoreline loadings are shown in Figure 7-6 (summer) and Figure 7-7 (winter).

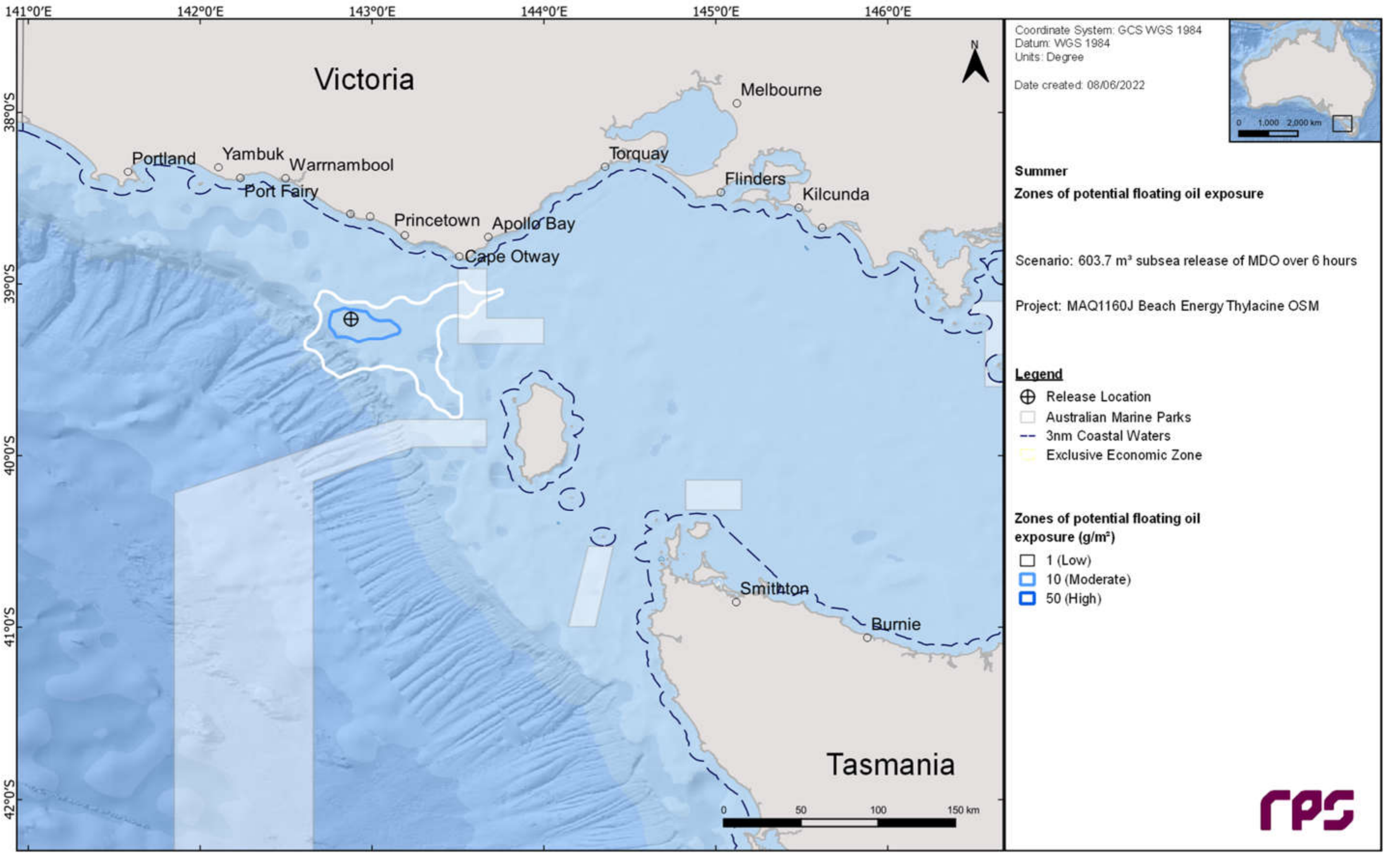


Figure 7-4: Zones of potential floating oil exposure during summer conditions

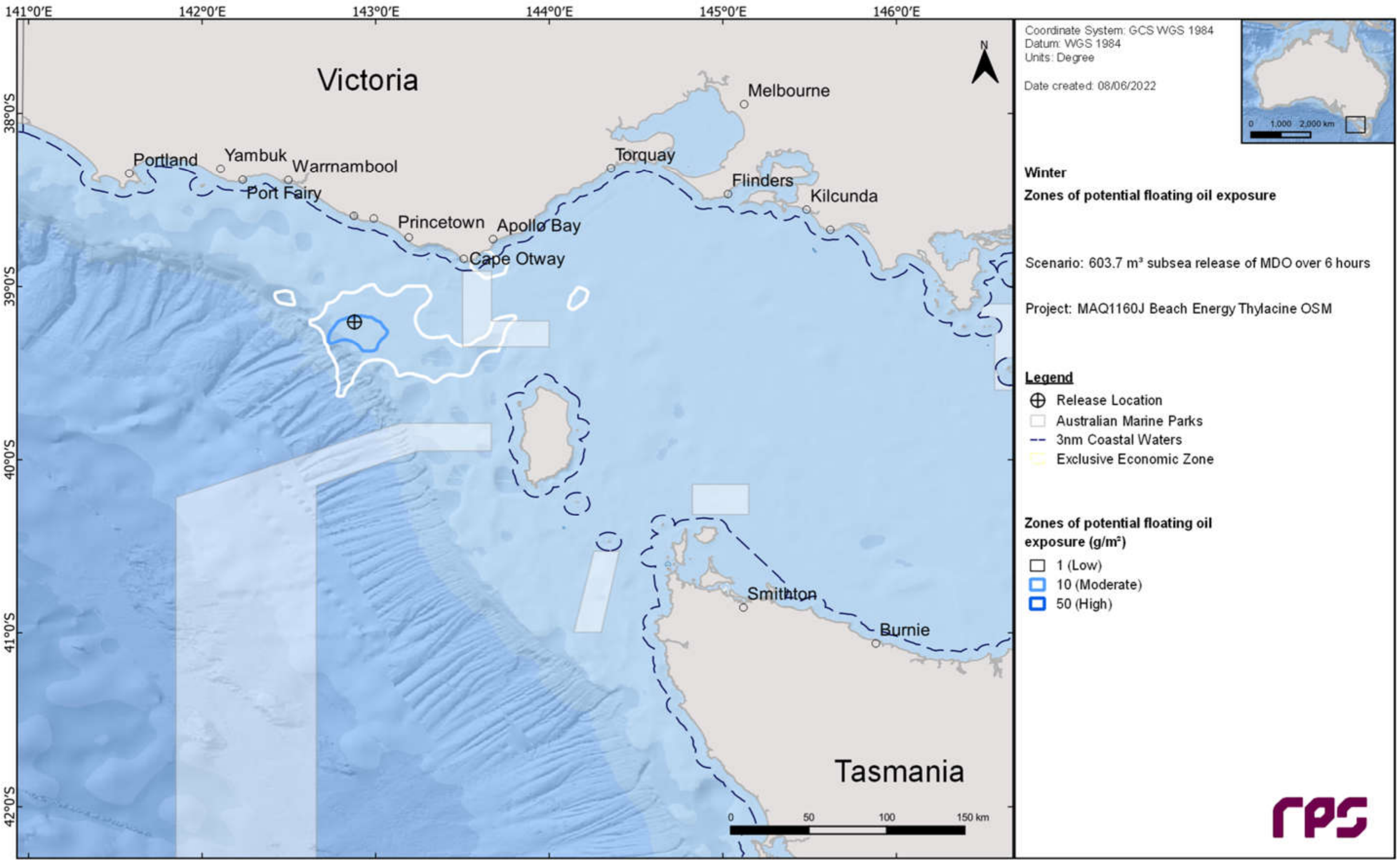


Figure 7-5: Zones of potential floating oil exposure during winter conditions

Table 7-23: Summary of oil accumulation on individual shoreline receptors (winter)

Shoreline	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Low	Mod	High	Low	Mod	High
King Island	11	6	-	5.54	7.58	-	0.6	24.6	17.9	4.4	-	42.4	11.1	-
Apollo Bay	2	1	-	3.96	4.25	-	0.1	13	6.6	5	-	11.1	5	-
Bay of Islands	2	1	-	7.83	10.54	-	< 0.1	8.5	7.6	5	-	12.1	5	-
Cape Otway West	3	2	-	3.25	8.92	-	< 0.1	4.1	8.4	2	-	16.2	3	-
Moonlight Head	1	1	-	4.00	4.46	-	< 0.1	2	5	2	-	5	2	-

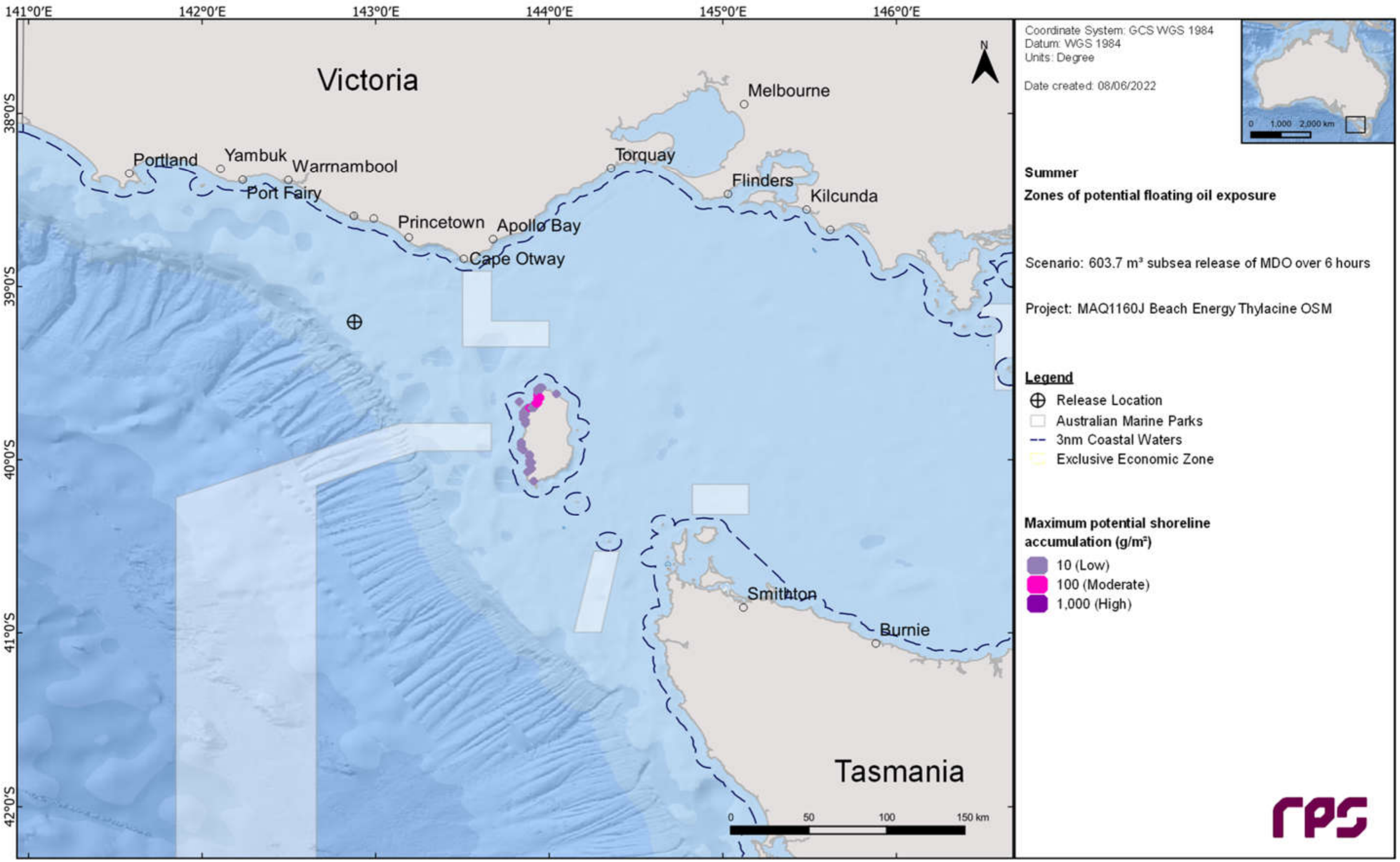


Figure 7-6: Maximum potential shoreline loading during summer conditions

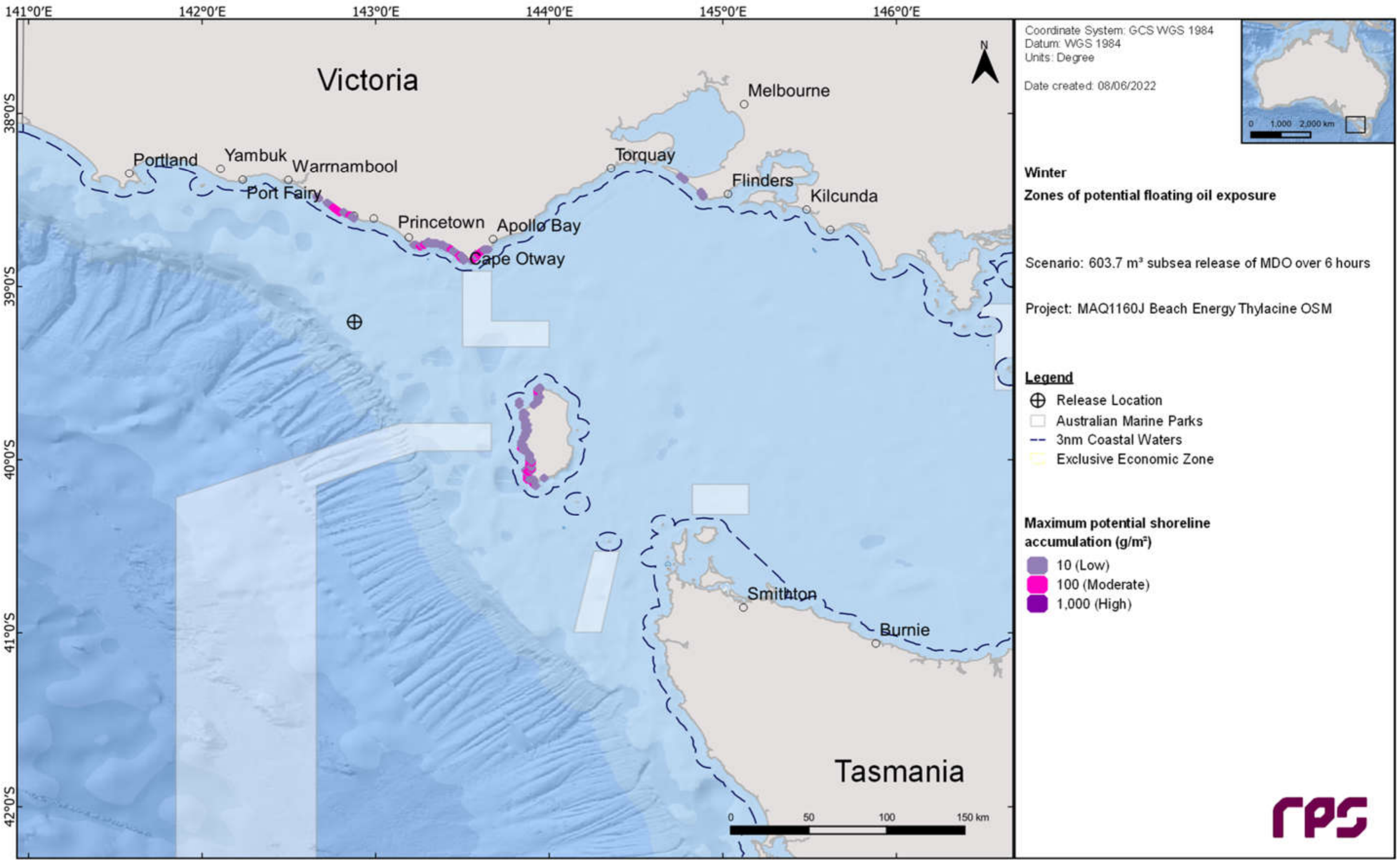


Figure 7-7: Maximum potential shoreline loading during winter conditions

Dissolved Hydrocarbons

The 14 BIAs which overlap the MDO release area (Table 7-22) all recorded dissolved hydrocarbon exposure at the moderate threshold for both the summer and winter seasons in the 0-10 m water column layer. These BIAs recorded the highest maximum instantaneous dissolved hydrocarbon exposures of 167 ppb (summer) and 180 ppb (winter) and 23% (summer) and 28% (winter) probability of contact at the moderate threshold. No other receptors were predicted to be exposed at the moderate threshold. No receptors were contacted at the high threshold.

Two other BIAs (Black-faced Cormorant – Foraging and White-faced Storm-petrel – Foraging) recorded contact at the low threshold. The Apollo AMP and the Zeehan AMP also recorded contact at the low threshold.

The zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea are shown in Figure 7-8 (summer) and Figure 7-9 (winter).

Entrained Hydrocarbons

The 14 BIAs which overlap the MDO release area (Table 7-22) all recorded entrained hydrocarbon exposure at the high threshold for both the summer and winter seasons in the 0-10 m water column layer. These BIAs recorded the highest maximum instantaneous entrained hydrocarbon exposures of 19,830 ppb (summer) and 17,931 ppb (winter) and 90% (summer) and 91% (winter) probability of contact at the high threshold.

Table 7-24 summarises the results for entrained hydrocarbon exposure in the 0-10 m water column layer:

- Five other BIAs (Black-faced Cormorant – Foraging; Little Penguin – Foraging; Southern Right Whale – Aggregation; Southern Right Whale - Connecting Habitat; White Shark – Foraging; White-faced Storm-petrel – Foraging) recorded entrained hydrocarbon exposure at the high threshold for both the summer and winter seasons. One BIA (Australasian Gannet – Foraging) recorded entrained hydrocarbon exposure at the low threshold.
- Two AMPs (Apollo and Zeehan) recorded entrained hydrocarbon exposure at the high threshold for both the summer and winter seasons. Two AMPs (Beagle and Fraanklin) recorded entrained hydrocarbon exposure at the low threshold.
- The West Tasmanian Canyons KEF recorded entrained hydrocarbon exposure at the high threshold for both the summer and winter seasons.
- No marine national parks recorded entrained hydrocarbon exposure at the high threshold. Four marine national parks (Point Addis; Port Phillip Heads; Twelve Apostles; Wilsons Promontory) recorded entrained hydrocarbon exposure at the low threshold.
- Bravenes Rock recorded entrained hydrocarbon exposure at the low threshold.
- The nearshore waters of Colac Otway, King Island, Apollo Bay and Cape Otway West recorded entrained hydrocarbon exposure at the low threshold.

The zones of potential entrained hydrocarbon exposure at 0-10 m below the sea are shown in Figure 7-10 (summer) and Figure 7-11 (winter).

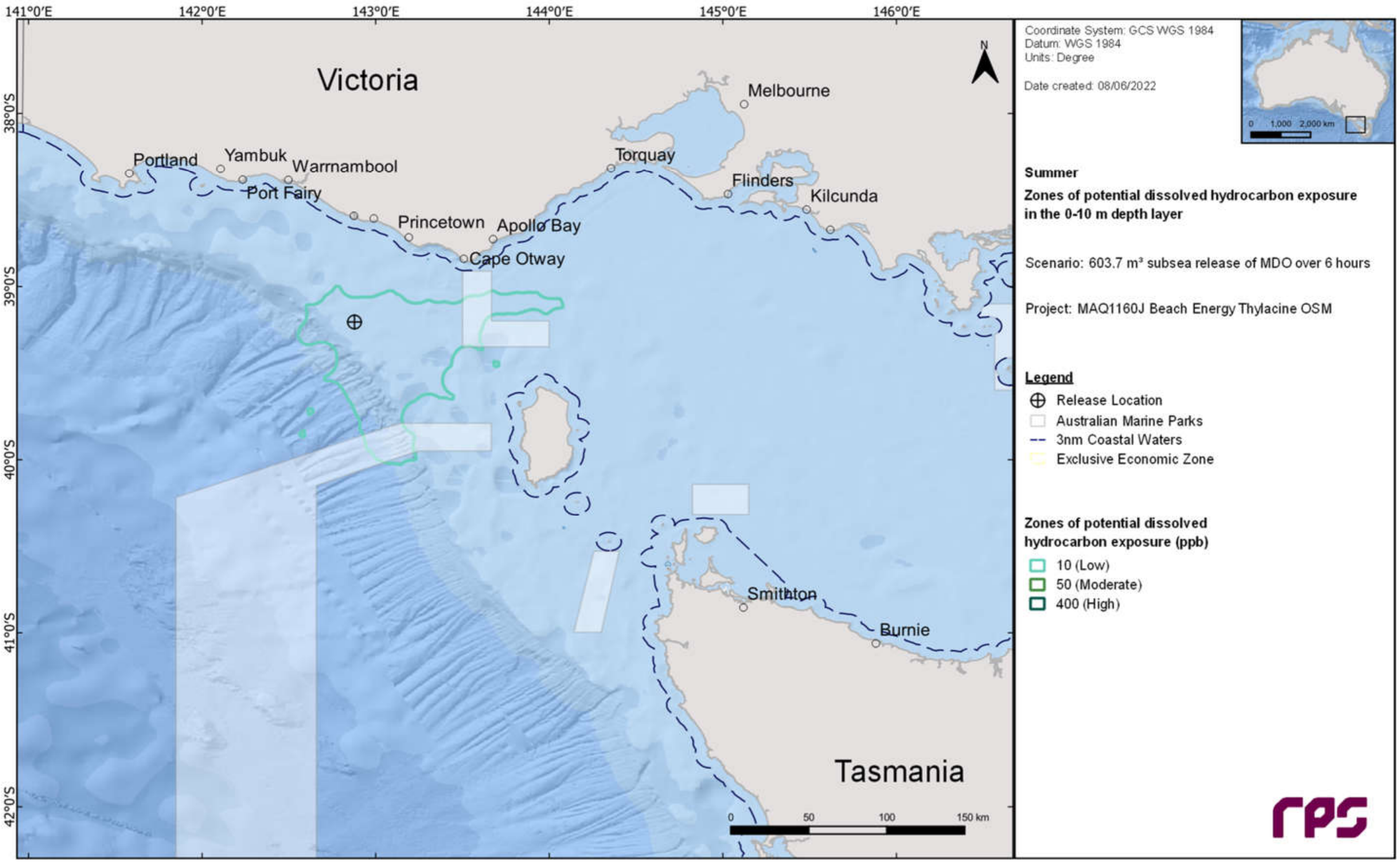


Figure 7-8: Zones of potential dissolved hydrocarbon exposure at 0-10 m during summer conditions

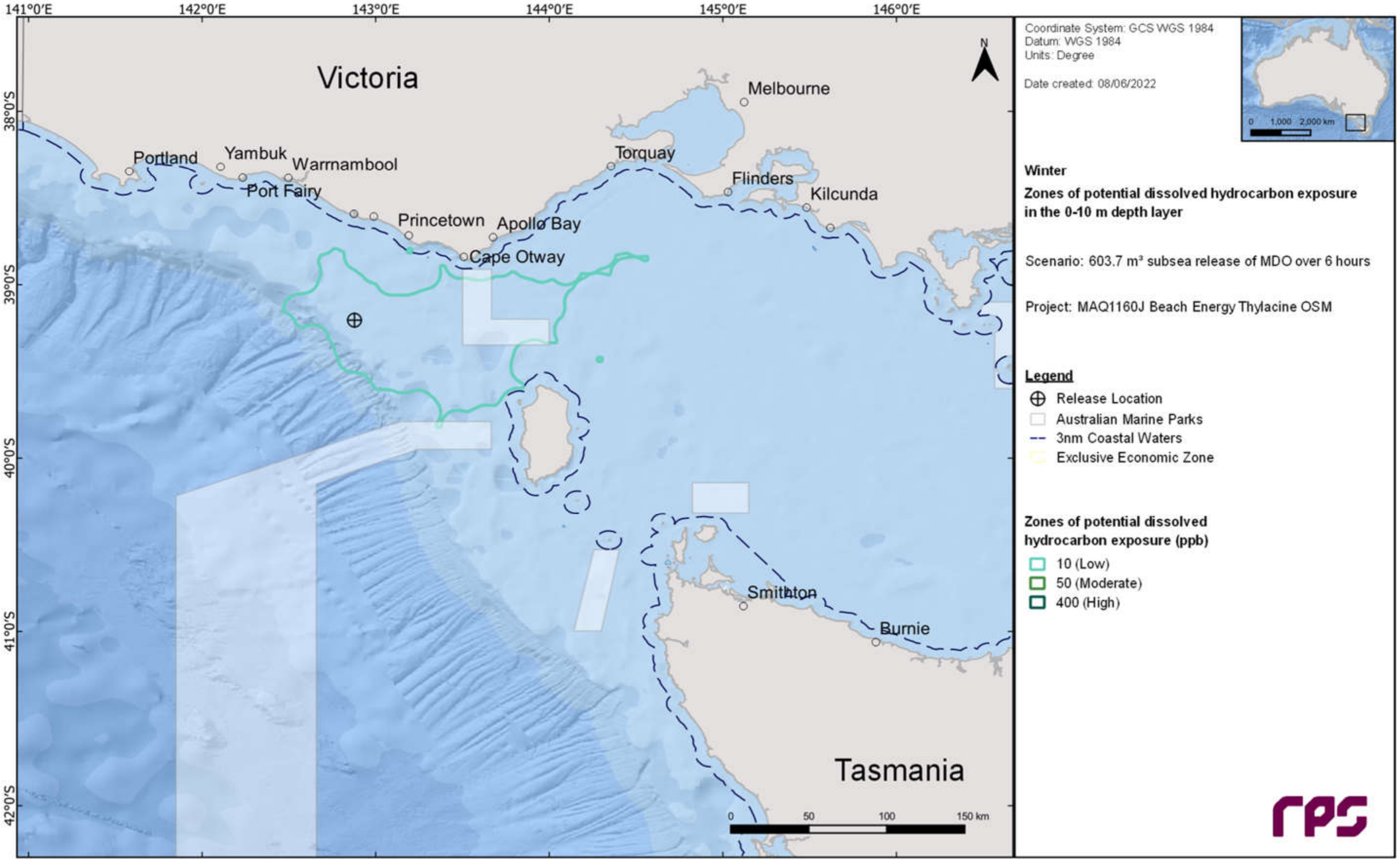


Figure 7-9: Zones of potential dissolved hydrocarbon exposure at 0-10 m during winter conditions

Table 7-24: Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure	
			Low	High		Low	High
AMP	Apollo	1,079	29	14	1,128	44	21
	Beagle	1	-	-	10	1	-
	Franklin	10	1	-	26	1	-
	Zeehan	251	23	5	286	23	8
BIA	Australasian Gannet – Foraging	27	6	-	45	5	-
	Black-faced Cormorant - Foraging	197	17	3	273	23	4
	Little Penguin - Foraging	184	16	1	253	20	4
	Southern Right Whale - Aggregation	20	2	-	167	2	2
	Southern Right Whale - Connecting Habitat	197	12	1	157	17	2
	White Shark - Foraging	30	6	-	146	10	1
	White-faced Storm-petrel - Foraging	443	20	5	547	33	8
KEF	West Tasmania Canyons	1,435	34	16	949	13	9
MNP	Point Addis	5	-	-	29	2	-
	Port Phillip Heads	-	-	-	11	1	-
	Twelve Apostles	25	2	-	49	3	-
	Wilsons Promontory	2	-	-	13	1	-
RSB	Bravenes Rock	103	1	1	185	6	2
Nearshore waters	Colac Otway	17	1	-	183	7	2
	King Island	197	12	1	157	17	2
	Apollo Bay	17	1	-	183	7	2
	Cape Otway West	11	1	-	133	6	1

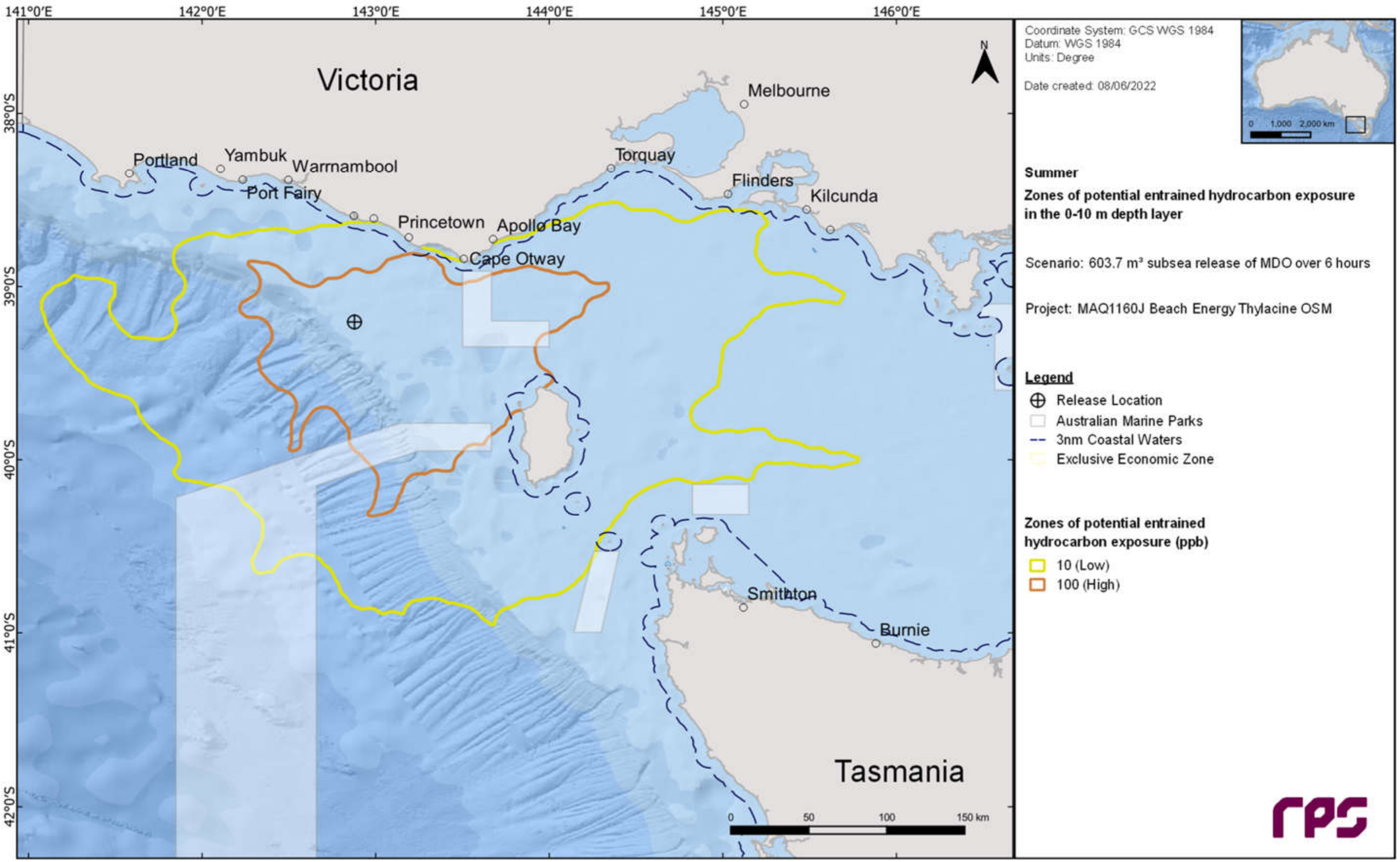


Figure 7-10: Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea during summer conditions

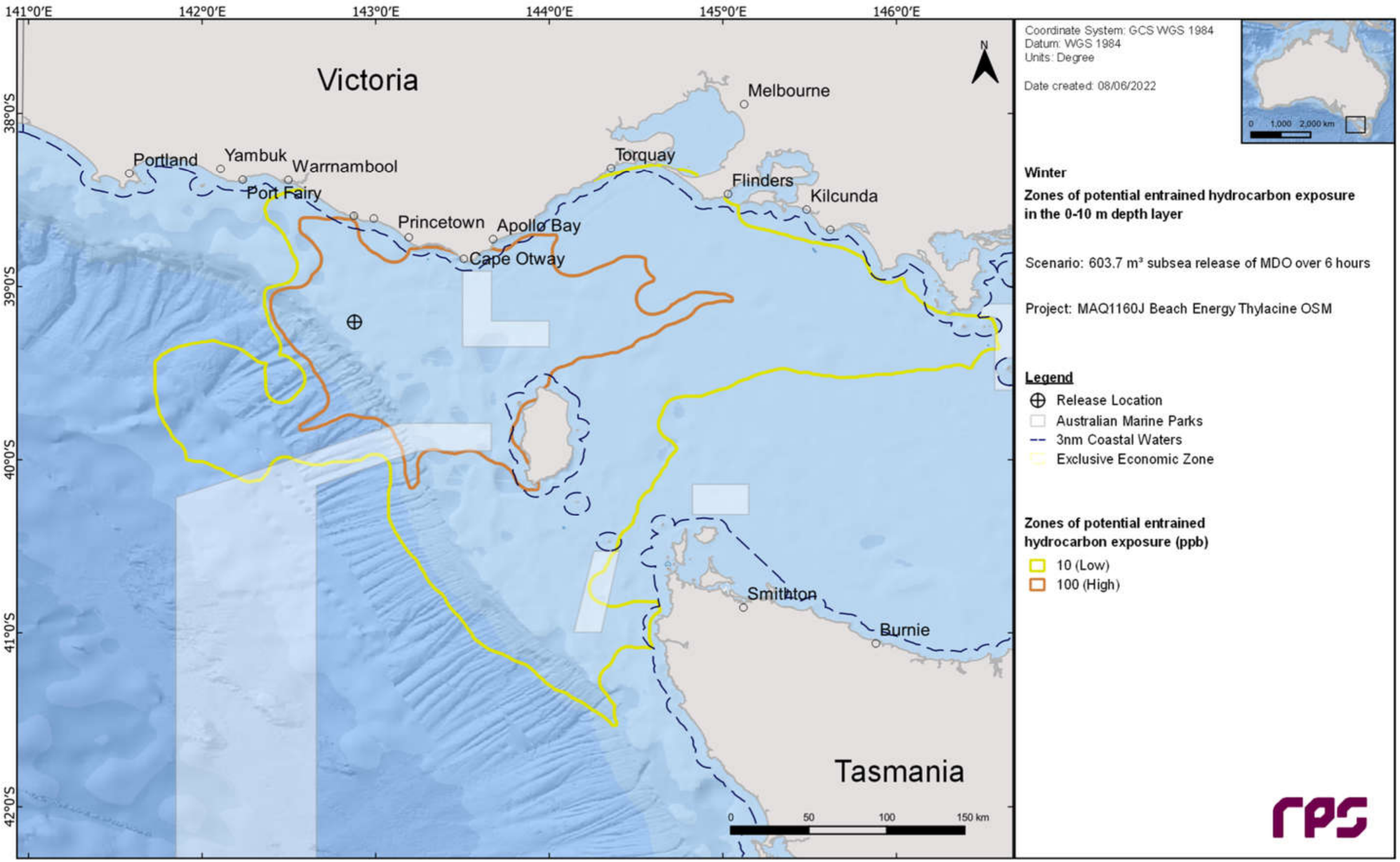


Figure 7-11: Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea during winter conditions

7.16.3 Known and potential environmental impacts

The known and potential environmental impacts of an MDO spill are:

- Change in water quality leading to:
  - Injury or mortality of fauna.
  - Change in fauna behaviour.
  - Change in ecosystem dynamics.
  - Changes to the functions, interests or activities of other users (e.g., commercial fisheries).

7.16.4 EMBA

The socio-economic EMBA (Figure 5-3) is useful for establishing scientific monitoring parameters and identifying potential socio-economic impacts; however, it may not be at concentrations that are ecologically significant (NOPSEMA, 2019). Therefore, in addition to the socio-economic EMBA, an ecological EMBA has also been derived from the stochastic spill modelling using hydrocarbon thresholds that are identified by NOPSEMA (2019) as having the potential to cause impacts to ecological receptors.

The impact assessment for an MDO spill is based on the moderate exposure levels for floating, shoreline and dissolved hydrocarbons, and the high exposure threshold for entrained hydrocarbons. The ecological EMBA for a 603.7 m^3 spill of MDO is based on these impact assessment thresholds as illustrated in Figure 7-4 to Figure 7-11. Receptors most at risk within this EMBA, whether resident or migratory, are:

- Benthic assemblages;
- Macroalgal communities;
- Plankton;
- Fish;
- Cetaceans;
- Pinnipeds;
- Marine reptiles;
- Avifauna;
- Commercial fisheries; and
- Shoreline habitats.

7.16.5 Evaluation of Environmental Risk

Circumstances resulting in a loss of containment of MDO (such as a vessel collision and subsequent fuel tank rupture) are a low probability events in open ocean areas without restricted navigation. Though shipping activity is relatively high adjacent to the activity area (see Section 5.6.4), modern navigational aids assist in reducing the likelihood of a collision event. Higher commercial and recreational vessel traffic occurs in and around ports and harbours, which is therefore where the greatest risk of collision occurs. While undertaking the activity, the CSV will often be stationary, thereby further reducing the risk of collision with third-party vessels.

Criteria for the sensitivity of receptors that may be affected by an MDO spill are presented earlier in Table 7-25. The impacts of the MDO spill scenario on key environmental receptors in the spill EMBA are discussed in Table 7-26 through Table 7-36.

Table 7-25: Criteria used to determine receptor sensitivity in the EMBA

Sensitivity	Protected areas	Species status	BIA	Coastal sensitivity	• Receptors in the EMBA
Low	State - no marine protected areas. Cth - multiple use zones are the dominant component of the protected area.	Species not threatened (or limited to only a few species of a particular faunal grouping). Present in the EMBA only occasionally or as vagrants. Populations known to recover rapidly from disturbance.	No BIA (or limited to only a few species of a particular faunal grouping).	Low sensitivity habitat, such as fine-grained beaches, exposed wave-cut platform and exposed rocky shores, with rapid recovery from oiling (~ 1 year or less). Public recreation beaches not present or not widely used. No harbours or marinas.	Benthic assemblages. Plankton. Pelagic fish. Macroalgae. Sandy beaches. Rocky shores.
Medium	State – no marine protected area. Cth - little to no special purpose zonation.	Species may be threatened (or some species of a particular faunal grouping). Species may or may not be present at time of activity. Some susceptibility to oiling. Populations may take a moderate time to recover from oiling.	Some intersection with one or more BIAs, generally for distribution or foraging rather than breeding.	Moderately sensitive habitat present, such as sheltered rocky rubble coasts, exposed tidal flats, gravel beaches, mixed sand and gravel beaches, with a medium recovery period from oiling (~2-5 years). Public recreation beaches present but not often used. No harbours or marinas.	Marine reptiles. Seabirds.
High	State - marine protected area present. Cth - special purposes zones are the dominant component of the protected area.	Species are threatened (or most species of a particular faunal grouping). Species known to be present at time of activity. Known to be susceptible to oiling. Populations may take a long time to recover from oiling.	Significant intersection with one or more BIAs, particularly with regard to breeding or migration.	Sensitive habitat present, such as mangrove, salt marshes, and sheltered tidal flats, with long recovery periods from oiling (> 5 years). Public recreation beaches present that are widely used. Busy harbours or marinas.	Cetaceans. Pinnipeds. Shorebirds. Commercial fishing. Marine parks.

Benthic assemblages

Table 7-26: Potential risk of MDO release on benthic assemblages

General sensitivity to oiling – benthic assemblages	
Sensitivity rating of benthic species and communities:	Low
A description of benthic fauna in the EMBA is provided in:	Section 5.5.1

Surface hydrocarbons

Benthic species are generally protected from exposure to surface hydrocarbon. The primary modes of exposure for benthic communities in oil spills include:

- Direct exposure to dispersed oil (e.g., physical smothering) where bottom discharges stay at the ocean bottom;
- Direct exposure to dispersed and non-dispersed oil (e.g., physical smothering) where oil sinks down from higher depths of the ocean;
- Direct exposure to dispersed and non-dispersed oil dissolved in sea water and/or partitioned onto sediment particles; and
- Indirect exposure to dispersed and non-dispersed oil through the food web (e.g., uptake of oiled plankton, detritus, prey, etc.) (NRDA, 2012).

Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle (to breed, breathe and feed). Therefore, surface hydrocarbons are not considered to pose a high risk to marine invertebrates except at locations where surface oil reaches shorelines.

Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g., crustaceans) will reduce the impact of hydrocarbon absorption through the surface membrane. Other invertebrates with no exoskeleton and larval forms may be more prone to impacts from pelagic hydrocarbons.

Water column/seabed hydrocarbons

Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms, while impacts to adult species is reduced as a result of the presence of an exoskeleton. Localised impacts to larval stages may occur which could impact on population recruitment that year. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost. For example, it has been demonstrated that it took 2-5 months for lobsters to lose their taint when exposed to a light hydrocarbon (NOAA, 2002).

Exposure to microscopic oil droplets may also impact aquatic biota either mechanically (especially filter feeders) or act as a conduit for exposure to semi-soluble hydrocarbons (that might be taken up by the gills or digestive tract) (McCay-French, 2009). Toxicity is primarily attributed to water soluble PAHs, specifically the substituted naphthalene (C_2 and C_3) as the higher C-ring compounds become insoluble and are not bioavailable. ANZECC/ARMCANZ (2000) identifies the following 96-hr LC50 concentrations for naphthalene (a key primary PAH dissolved phase toxicant in crude oils):

- For the bivalve mollusc, *Katelysia opima*, a concentration of 57,000 ppb; and
- For six species of marine crustaceans, a concentration between 850 and 5,700 ppb.

Other possible impacts from the presence of dispersed and non-dispersed oil include effects of oxygen depletion in bottom waters due to bacterial metabolism of oil (and/or dispersants), and light deprivation under surface oil (NRDA, 2012).

Surveys undertaken after the Montara well blowout in the Timor Sea in 2009 found no obvious visual signs of major disturbance at Barracouta and Vulcan shoals (Heyward *et al.*, 2010), which occur about 20-30 m below the water line in otherwise deep waters (generally >150 m water depth). Later sampling indicated the presence of low-level severely degraded oil at some shoals, though in the absence of pre-impact data, this could not be directly linked to the Montara spill. Levels of hydrocarbons in the sediments were, in any case, several orders of magnitude lower than levels at which biological effects become possible (Heyward *et al.*, 2012; Gagnon & Rawson, 2011).

Studies undertaken since the Macondo well blowout in the Gulf of Mexico (GoM) in 2010 have shown that fewer than 2% of the more than 8,000 sediment samples collected exceeded the EPA sediment toxicity benchmark for aquatic life, and these were largely limited to the area close to the wellhead (BP, 2015).

Studies of offshore benthic seaweeds in the northwest GoM prior to and after the Macondo well blowout at Sackett and Ewing banks (in water depths of 55-75 m) found a dramatic die-off of seaweeds after the spill (60 species pre-spill compared with 10 species post-spill) (Felder *et al*., 2014). Benthic decapod assemblages (crabs, lobsters, prawns) associated with the seaweeds and benthic substrate also showed a strong decline in abundance at both banks post-spill (species richness on Ewing Bank reduced by 42% and on Sackett Bank by 29%), though it is noted that these banks are exposed to influences from Mississippi River discharges that vary year to year, so definitive links to the oil spill are not possible. It is noted, however, that petroleum residues were observed on Ewing Bank and it is possible that this may have caused localized mortalities, reduced the fecundity of surviving female decapods or reduced recruitment (Felder *et al*., 2014). Felder *et al* (2014) also notes that freshly caught soft-sediment decapod samples caught in early and mid-2011 near the spill site exhibited lesions that were severe enough to cause appendage loss and mortality.

Recovery of benthic habitats exposed to entrained hydrocarbons would be expected to return to background water quality conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Committee on Oil in the Sea, 2003).

Potential consequence from an MDO spill			
Sea Surface	**Water column - dissolved phase**	**Water column – entrained phase**	**Shoreline**
Not applicable.	Only contact at the low and moderate threshold was predicted in waters 0-10 m below the surface. There is no modelled exposure to the high threshold for dissolved hydrocarbons. At the low threshold exposure to dissolved hydrocarbons, ecological impacts are unlikely. In nearshore waters (0-10 m) where there is interaction with the benthic environment, there is no probability of moderate threshold exposure. At the moderate threshold, sub-lethal impacts to benthic fauna may occur as described above. Due to the limited extent of dissolved hydrocarbons at the moderate threshold in nearshore benthic environments, the consequence to benthic fauna or habitats from an MDO spill is **minor**.	There are areas of low exposure entrained hydrocarbons in the nearshore benthic zone on the northwest coast of Tasmania, on King Island, on the Mornington Peninsula, the Moncoeur Islands, Rodondo Island and on the Victorian coast between Anglesea and Warnambool. This concentration is not considered to impart ecological impact, rather this threshold is more suited to establishing the planning area for scientific monitoring (NOPSEMA 2019). Thus, the area intersected by this threshold is considered outside the adverse exposure zone when considering benthic assemblages. The consequence to benthic fauna or habitats exposed to hydrocarbons at the low threshold is **negligible.** There are some areas of high exposure to entrained hydrocarbons in the nearshore benthic zone on the north and west coast of King Island, and on the Victorian coast near Cape Otway and near Port Campbell. Settlement of high threshold entrained MDO in the benthic layer is unlikely due to the	The low threshold (10 g/m^2) for shoreline accumulation applied to the OSTM represents the trigger for socio-economic impact including the temporary closure of beaches to recreation or fishing (RPS, 2020b). As such, the moderate threshold (100 g/m^2) has been applied as the minimum threshold to define ecological impact (French *et al.,* 1996; French-McCay, 2009). There is a 6% probability of contact with moderate threshold exposure to shorelines at King Island and 1-2% probability of contact on the Victorian coast near Cape Otway and near Port Campbell. The maximum length of shoreline predicted to be contacted at or above the moderate threshold is 11.1 km. The high threshold (1000 g/m^2) for shoreline loading, which is associated with higher potential for ecological impact, was not reached during the 200 simulations of the scenario undertaken in the modelling (RPS, 2022). Intertidal benthic species would be exposed to MDO (albeit weathered) along limited sections

		properties of the MDO. As such, the consequence of a hydrocarbon spill on benthic assemblages is **minor**.	of shorelines. Resident fauna such as worms, molluscs and crustaceans may suffer sub-lethal and lethal impacts where hydrocarbon loadings penetrate into the sediments and persist. While MDO penetrates porous sediments (e.g., sand) quickly, it is also washed off quickly (and weathered within sediments) by waves (NOAA, 2012), thus minimising impacts to intertidal fauna. Similarly, the exposed rock cliffs and intertidal platforms present on the small islands will facilitate weathering of the hydrocarbons through wave action pounding on the rocks). Therefore, the consequence of an MDO spill on benthic assemblages is **minor**.

Macroalgal communities

Table 7-27: Potential risk of MDO release from vessel on macroalgal communities

General sensitivity to oiling – macroalgal communities	
Sensitivity rating of macroalgal species and communities:	Low
A description of macroalgal species and communities in the EMBA is provided in:	Section 5.5.1.3

Macroalgae are generally limited to growing on intertidal and subtidal rocky substrata in shallow waters to 10 m depth. As such, they may be exposed to subsurface entrained and dissolved hydrocarbons, as well as to surface hydrocarbons if present in intertidal habitats as opposed to subtidal habitats.

Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer, 1971; Cintron *et al*., 1981). In macroalgae, oil can act as a physical barrier for the diffusion of CO_2 across cell walls (O'Brian & Dixon, 1976). The effect of hydrocarbons however is largely dependent on the degree of direct exposure and how much of the hydrocarbon adheres to algae, which will vary depending on the oils physical state and relative 'stickiness'. The morphological features of macroalgae, such as the presence of a mucilage layer or the presence of fine 'hairs' will influence the amount of hydrocarbon that will adhere to the algae. A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. The rapid recovery of algae was attributed to the fact that for most algae, new growth is produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are continually lost. Other studies have indicated that oiled kelp beds had a 90% recovery within 3-4 years of impact, however full recovery to pre-spill diversity may not occur for long periods after the spill (French-McCay, 2004).

Intertidal macroalgal beds are more prone to oil spills than subtidal beds because although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy can increase the persistence of the oil, which impacts upon site-attached species. Additionally, when oil sticks to dry fronds on the shore, they can become overweight and break as a result of wave action (IPIECA, 2002).

The toxicity of macroalgae to hydrocarbons varies for the different macroalgal life stages, with water-soluble hydrocarbons more toxic to macroalgae (Van Overbeek & Blondeau, 1954; Kauss *et al*., 1973; cited in O'Brien and Dixon, 1976). Toxic effect concentrations for hydrocarbons and algae have varied greatly among species and studies, ranging 0.002–10,000 ppm (Lewis & Pryor, 2013). The sensitivity of gametes, larva and zygote stages however have all proven more responsive to petroleum oil exposure than adult growth stages (Thursby & Steele, 2003; Lewis & Pryor, 2013).

Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. So, in addition to the potential impacts from direct smothering or exposure to entrained and dissolved hydrocarbons, the presence of entrained hydrocarbons within the water column can affect light qualities and the ability of macrophytes to photosynthesise.

Potential consequence from an MDO spill			
Sea surface	**Water column – dissolved phase**	**Water column – entrained phase**	**Shoreline**
Floating vegetation in western Bass Strait may be exposed to limited areas of moderate threshold hydrocarbons at the sea surface. There are no areas of moderate or high threshold sea surface hydrocarbons in the nearshore environment. The nature of the spill in this scenario (occurring in deep waters)	Only contact at the low and moderate threshold was predicted in waters 0-10 m below the surface. There is no modelled exposure to the high threshold for dissolved hydrocarbons. In nearshore waters (0-10 m), where there is greater risk of interaction with macroalgal	There are areas of low exposure entrained hydrocarbons in the nearshore benthic zone on the northwest coast of Tasmania, on King Island, on the Mornington Peninsula, the Moncoeur Islands, Rodondo Island and on the Victorian coast between Anglesea and Warnambool. This concentration is not considered to impart ecological impact, rather	Shoreline accumulation of hydrocarbons at the low threshold is unlikely to have an ecological impact. There are no areas of exposure to high threshold hydrocarbons, which are likely to have an ecological impact.

means the consequence to macroalgal communities is **minor**.	communities, there is no contact at the moderate threshold. Due to the low concentrations and physical properties of the hydrocarbons and the well-mixed nature of the waters of the EMBA, ecological impact to macroalgae communities by hydrocarbons is considered highly unlikely, particularly in high-energy nearshore environments. Thus, the consequence to macroalgal communities from an MDO spill is **minor**.	this threshold is more suited to establishing the planning area for scientific monitoring (NOPSEMA 2019). Thus, the area intersected by this threshold is considered outside the adverse exposure zone when considering macroalgal communities. The consequence to macroalgal communities exposed to hydrocarbons at the low threshold is **negligible.** The Giant Kelp Forest TEC may be intersected by areas of high concentration entrained hydrocarbons around the north and west coast of King Island, and on the Victorian coast near Cape Otway and near Port Campbell. Settlement of high threshold entrained MDO in the benthic layer is unlikely due to the properties of the MDO. As such, the consequence of a hydrocarbon spill on macroalgal communities is **minor**.	There is a 6% probability of contact with moderate threshold exposure to shorelines at King Island and 1-2% probability of contact on the Victorian coast near Cape Otway and near Port Campbell. The maximum length of shoreline predicted to be contacted at or above the moderate threshold is 11.0 km. At this threshold, there may be ecological impacts to macroalgae stranded on the shoreline. However, wave-action at the shoreline will naturally disperse and weather the hydrocarbons quickly. Therefore, the consequence of the MDO spill to macroalgal communities is **minor**.

Plankton

Table 7-28: Potential risk of MDO release on plankton

General sensitivity to oiling – plankton	
Sensitivity rating of plankton:	Low
A description of plankton communities in the EMBA is provided in:	Section 5.5.4

Plankton is found in nearshore and open waters beneath the surface in the water column. These organisms migrate vertically through the water column to feed in surface waters at night (NRDA, 2012). As they move close to the sea surface it is possible that they may be exposed to both surface hydrocarbons but to a greater extent, hydrocarbons dissolved or entrained in the water column.

Phytoplankton is typically not sensitive to the impacts of oil, though they do accumulate it rapidly due to their small size and high surface area to volume ratio (Hook *et al*., 2016). If phytoplankton is exposed to hydrocarbons at the sea surface, this may directly affect their ability to photosynthesize and would have implications for the next trophic level in the food chain (e.g., small fish) (Hook *et al*., 2016). In addition, the presence of surface hydrocarbons may result in a reduction of light penetrating the water column, which could affect the rate of photosynthesis for phytoplankton in instances where there is prolonged presence of surface hydrocarbons over an extensive area such that the phytoplankton was restricted from exposure to light. Oil can affect the rate of photosynthesis and inhibit growth in phytoplankton, depending on the concentration range. For example, photosynthesis is stimulated by low concentrations of oil in the water column (10-30 ppb), but become progressively inhibited above 50 ppb. Conversely, photosynthesis can be stimulated below 100 ppb for exposure to weathered oil (Volkman *et al*., 2004).

Zooplankton (microscopic animals such as rotifers, copepods and krill that feed on phytoplankton) are vulnerable to hydrocarbons due to their small size and high surface area to volume ratio, along with (in many cases) their high lipid content (that facilitates hydrocarbon uptake) (Hook *et al*., 2016). Water column organisms that come into contact with oil risk exposure through ingestion, inhalation and dermal contact (NRDA, 2012), which can cause immediate mortality or declines in egg production and hatching rates along with a decline in swimming speeds (Hook *et al*., 2016).

Plankton is generally abundant in the upper layers of the water column and acts as the basis for the marine food web, meaning that a MDO spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Variations in the temporal scale of oceanographic processes typical of the ecosystem have a greater influence on plankton communities than the direct effect of spilt hydrocarbons. This is because reproduction by survivors or migration from unaffected areas would be likely to rapidly replenish any losses from permanent zooplankton (Volkman *et al*., 2004).

Field observations from oil spills show minimal or transient effects on marine plankton (Volkman *et al*., 2004). Once background water quality conditions have re-established, the plankton community will take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics.

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
Plankton found in open water of the EMBA is expected to be widely represented in wider Bass Strait. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by surface, dissolved and entrained hydrocarbons. Once background water quality conditions are re-established following the natural weathering and dispersion of the hydrocarbons, plankton populations are expected to recover rapidly due to recruitment of plankton from surrounding waters. The consequence of an MDO spill on plankton populations is **minor**.		Not applicable.

Fish

Table 7-29: Potential risk of MDO release on fish

General sensitivity to oiling –fish	
Sensitivity rating of pelagic fish	Low
A description of pelagic fish in the EMBA is provided in:	Section 5.5.6

The behaviours and habitat preferences of fish species determine their potential for exposure to hydrocarbons and the resulting impacts. Demersal species may be susceptible to oiled sediments, particularly species that are site-restricted. Pelagic species that occupy the water column are more susceptible to entrained and dissolved hydrocarbons, however generally these species are highly mobile and as such are not likely to suffer extended exposure due to their patterns of movement. The exception would be in areas such as reefs and other seabed features where species are less likely to move away into open waters (i.e., they area site-attached).

Fish are exposed to hydrocarbon droplets through a variety of pathways, including:

Direct dermal contact (e.g., swimming through oil or waters with elevated dissolved hydrocarbon concentrations and other constituents, with diffusion across their gills (Hook et al., 2016));

Ingestion (e.g., directly or via food base, fish that have recently ingested contaminated prey may themselves be a source of contamination for their predators); and

Inhalation (e.g., elevated dissolved contaminant concentrations in water passing over the gills).

Exposure to hydrocarbons at the surface or entrained or dissolved in the water column can be toxic to fish. Studies have shown a range of impacts including changes in abundance, decreased size, inhibited swimming ability, changes to oxygen consumption and respiration, changes to reproduction, immune system responses, DNA damage, visible skin and organ lesions, and increased parasitism. However, many fish species can metabolise toxic hydrocarbons, which reduces the risk of bioaccumulation of contaminants in the food web (and human exposure to contaminants through the consumption of seafood) (NRDA, 2012).

Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling and burrowing behaviour (Kennish, 1996). However, fish are high mobile and unlikely to remain in the area of a spill for long enough to be exposed to sub-lethal doses of hydrocarbons.

Fish are most vulnerable to hydrocarbon discharges during their embryonic, larval and juvenile life stages. Eggs and larvae of many fish species are highly sensitive to oil exposure, resulting in decreased spawning success and abnormal larval development (see Table 7-28).

Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman et al., 2004). As a result, wide-ranging pelagic fish of the open ocean generally are not highly susceptible to impacts from surface hydrocarbons. Adult fish kills reported after oil spills occur mainly to shallow water, near-shore benthic species (Volkman et al., 2004).

Hydrocarbon in the water column can physically affect reef fish (that have high site fidelity and cannot move out of harm's way) exposed for an extended duration (weeks to months) by coating of gills, leading to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces that may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food, leading to reduced growth (Volkman et al., 2004).

The threshold value for species toxicity in the water column is based on global data from French et al. (1999) and French-McCay (2002, 2003), which showed that species sensitivity (fish and invertebrates) to dissolved aromatics exposure >4 days (96-hour LC50) under different environmental conditions varied from 6 to 400 µg/L (ppb), with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae). Based on scientific literature, a minimum threshold of 6 ppb over 96 hours or equivalent was used to assess in-water low exposure zones, respectively (Engelhardt, 1983; Clark, 1984; Geraci and St Aubin, 1988; Jenssen, 1994; Tsvetnenko, 1998). French-McCay (2002) indicates that an average 96-hour LC50 of 50 ppb and 400 ppb could serve as an acute lethal threshold to 50% and 97.5% to biota, respectively.

Studies of oil impacts on bony fishes report that light, volatile oils are likely to be more toxic to fish. Many studies conclude that exposure to PAHs and soluble compounds are responsible for the majority of toxic impacts observed in fish (e.g., Carls et al., 2008; Ramachandran et al., 2004). A range of lethal and sub-lethal effects to fish in the larval stage has been reported at water-accommodated fraction (WAF) hydrocarbon concentrations (48–hour and 96-hour exposures) of 0.001 to 0.018 ppm during laboratory exposures (Carls et al., 2008; Gala, 2001). In contrast, wave tank exposures reported much higher lethal concentrations (14-day LC50) up to 1.9 ppm for herring embryos and up to 4.3 ppm for juvenile cod (Lee et al., 2011).

Toxicity in adult fish has been reported in response to crude oils, HFO and diesel (Holdway, 2002; Shigenaka, 2011). Uptake of hydrocarbons has been demonstrated in bony fish after exposure to WAF of between 24 and 48 hours. Danion et al (2011) observed PAH uptake of 148 µg/kg-1 after 48-hour exposures to PAH from Arabian Crude at high concentrations of 770 ppm. Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm. The majority of studies, either from laboratory trials or of fish collected after spill events (including the Hebei Spirit, Macondo, and Sea Empress spills) find evidence of elimination of PAHs in fish tissues returning to reference levels within two months of exposure (Challenger and Mauseth, 2011; Davis et al., 2002; Gagnon & Rawson, 2011; Gohlke et al., 2011; Jung, 2011; Law, 1997; Rawson et al., 2011).

During most of their lives, squid are widely distributed, however, when squid reach maturity at 1-2 years, they move inshore to spawn in large numbers and then die after spawning. Where large numbers of squid spawn in small areas, the population could be impacted by the reduction in successful spawn. As squid are generally abundant and reach sexual maturity rapidly, recovery is expected to be rapid (1-2 years) (Minerals Management Service, 1983).

The toxicity of dissolved hydrocarbons and dispersed oil to fish species has been the subject of a number of laboratory studies (AMSA, 1998). Generally, concentrations in the range of 0.1–0.4 mg/L dispersed oil have been shown to cause fish deaths in laboratory experiments (96-hour LC50). No reported studies of the impacts of oil spills on cartilaginous fish (including sharks, rays and sawfish) were found in the literature. It is not known how the data on the sensitivity of bony fishes would relate to toxicity in cartilaginous fishes.

The assessment of effects on fish species in the Timor Sea as a result of the Montara well blowout (a light gas condensate), conducted from November 2009 to November 2010 undertaken by Gagnon & Rawson (2011), found that of the species studied (mostly goldband snapper Pristipomoides multidens, red emperor Lutjanus sebae, rainbow runner Elegatis bipinnulata and Spanish mackerel Scomberomorus commerson), all 781 specimens were in good physical health at all sites. Results show that:

Phase 1 study (November 2009, immediately after the blowout ceased) - indicated that in the short-term, fish were exposed to and metabolised petroleum hydrocarbons, however no consistent adverse effects on fish health or their reproductive activity were detected.

Phase 2 study (March 2010, 5 months after the blowout ceased) – indicated continuing exposure to petroleum hydrocarbons, as detected by elevated liver detoxification enzymes and PAH biliary metabolites in three out of four species collected close to the MODU, and elevated oxidative DNA damage.

Phase 3 study (November 2010, 12 months after the blowout ceased) – showed a trend towards a return to reference levels with often, but not always, comparable biomarker levels in fish collected from reference and impacted sites. This evidence of exposure to petroleum hydrocarbons at sites close to the spill location suggest an ongoing trend toward a return to normal biochemistry/physiology (Gagnon & Rawson, 2011).

The main finding of the Gagnon & Rawson (2011) study concluded that there were no detectable petroleum hydrocarbons found in the fish muscle samples, limited ill effects were detected in a small number of individual fish, and no consistent adverse effects of exposure on fish health could be detected within two weeks following the end of the well release. Notwithstanding, fishes from close to the Montara well, collected seven months after the discharge began, showed continuing exposure to hydrocarbons in terms of biomarker responses. Two years after the discharge, biomarker levels in fishes had mostly returned to reference levels, except for liver size. However this was potentially attributed to local nutrient enrichment, or to past exposure to hydrocarbons. Fishes near Heyward Shoal, approximately 100 km southwest of the Montara well, had elevated biomarker responses indicating exposure to hydrocarbons, but were collected close to the Cornea natural hydrocarbon seep. Studies on the Montara discharge have shown recovery in terms of the abundance and composition of fishes, and toxicological and physiological responses of fishes.

Sampling from January 2010 to June 2011 by the University of South Alabama and Dauphin Island Sea Lab found no significant evidence of diseased fish in reef populations off Alabama or the western Florida Panhandle as a result of the Macondo well blowout in the GoM (BP, 2014).

No reports of oil spills in open waters have been reported to cause fish kills (though mortality in aquaculture pens has), which is likely to be because vertebrates can rapidly metabolise and excrete hydrocarbons (Hook et al., 2016).

Recovery of fish assemblages depends on the intensity and duration of an unplanned discharge, the composition of the discharge and whether dispersants are used, as each of these factors influences the level of exposure to potential toxicants. Recovery would also depend on the life cycle attributes of fishes. Species that are abundant, short-lived and highly fecund may recover rapidly. However less abundant, long-lived species may take longer to recover. The range of movement of fishes will also influence recovery. The nature of the receiving environment would influence the level of impact on fishes.

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
There is a small area in which moderate exposure (24.5 km) and high exposure (11.9 km) threshold hydrocarbons travel from the activity area on the sea surface. Fish species in the water column and syngnathid species associated with rafts of floating seaweed may come into contact with surface oil, however the maximum distance of moderate exposure threshold from the release site (representing the point at which harmful effects may be encountered) represents a relatively small area of the sea surface in comparison to the wider Bass Strait. Because the majority of fish tend to remain in the mid-pelagic zone, they are not likely to come into contact with surface hydrocarbons, so the consequence of an MDO spill is **minor**.	Impacts to fish from exposure to hydrocarbons in the water column is likely to be spatially and temporally limited. The OSTM indicates that exposure to high threshold entrained hydrocarbons (i.e., the concentration at which biological impact may occur) is predicted to occur up to a maximum distance of 150 km east from the activity area. This concentration represents the possibility of sub-lethal impacts to exposed fish species in the affected area. NOAA (2013) and ITOPF (2011a) state that hydrocarbon spills in open water are so rapidly diluted that fish kills are rarely observed. In addition, due to the properties of MDO, there are no hydrocarbons predicted below 10 m water depth. Fish such as the great white shark, shortfin mako and porbeagle shark spend most of their time in the water column (rather than surface waters), meaning they are more likely to be exposed to entrained and dissolved hydrocarbons than surface hydrocarbons. As highly mobile species, they are unlikely to remain in one area for a long period of time, minimising the risk that they would be exposed to toxic levels of hydrocarbons. Due to Bass Strait's generally well-mixed waters, and the high and rapid rate of MDO weathering, the consequence of an MDO spill on for fish is restricted to the top 10 m of water and is **minor** at a population level.	Not applicable

Cetaceans

Table 7-30: Potential risk of MDO release on cetaceans

General sensitivity to oiling – cetaceans	
Sensitivity rating of cetaceans:	High
A description of cetaceans in the EMBA is provided in:	Section 5.4.5

Whales and dolphins can be exposed to the chemicals in oil through:

- Internal exposure by consuming oil or contaminated prey;
- Inhaling volatile oil compounds when surfacing to breathe;
- Dermal contact, by swimming in oil and having oil directly on the skin and body; and
- Maternal transfer of contaminants to embryos (NRDA, 2012; Hook *et al.*, 2016).

The effects of this exposure include:

- Hypothermia due to conductance changes in skin, resulting in metabolic shock (expected to be more problematic for non-cetaceans in colder waters);
- Toxic effects and secondary organ dysfunction due to ingestion of oil;
- Congested lungs;
- Damaged airways;
- Interstitial emphysema due to inhalation of oil droplets and vapour;
- Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding;
- Eye and skin lesions from continuous exposure to oil;
- Decreased body mass due to restricted diet; and
- Stress due to oil exposure and behavioural changes.

French-McCay (2009) identifies that a 10-25 µm oil thickness threshold has the potential to impart a lethal dose on marine species, however also estimates a probability of 0.1% mortality to cetaceans if they encounter these thresholds based on the proportion of the time spent at surface. Direct surface oil contact with hydrocarbons is considered to have little deleterious effect on whales, possibly due to the skin's effectiveness as a barrier to toxicity, and effect of oil on cetacean skin is probably minor and temporary (Geraci & St Aubin, 1988). Cetaceans in particular have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces such as barnacled skin. Oil tends to adhere to rough surfaces, hair or calluses of animals, so contact with hydrocarbons by whales and dolphins may cause only minor hydrocarbon adherence.

The physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are both applicable to entrained oil. However, the susceptibility of cetaceans varies with feeding habits. Baleen whales (such as blue, southern right and humpback whales) are not particularly susceptible to ingestion of oil in the water column, but are susceptible to oil at the sea surface as they feed by skimming the surface. Oil may stick to the baleen while they 'filter feed' near slicks. Sticky, tar-like residues are particularly likely to foul the baleen plates.

The inhalation of oil droplets, vapours and fumes is a distinct possibility if whales surface in slicks to breathe. Exposure to hydrocarbons in this way could damage mucous membranes, damage airways or even cause death.

Toothed whales and dolphins may be susceptible to ingestion of dissolved and entrained oil as they gulp feed at depth. There are reports of declines in the health of individual pods of killer whales (a toothed whale species), though not the population as a whole, in Prince William Sound after the Exxon Valdez vessel spill (heavy oil) (Hook *et al.*, 2016).

It has been stated that pelagic species will avoid hydrocarbons, mainly because of its noxious odours, but this has not been proven. The strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. So weathered or tar-like oil residues can still present a problem by fouling baleen whale feeding systems.

Dolphin populations from Barataria Bay, Louisianna, USA, which were exposed to prolonged and continuous oiling from the Macondo oil spill in 2010, had higher incidences of lung and kidney disease than those in the other urbanised environments (Hook *et al.*, 2016). The spill may have also contributed to unusually high perinatal mortality in bottlenose dolphins (Hook *et al.*, 2016).

As highly mobile species, in general it is very unlikely that cetaceans will be constantly exposed to concentrations of hydrocarbons in the water column for continuous durations (e.g., >96 hours) that would lead to chronic toxicity effects.

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
There is a small area in which moderate exposure (24.5 km) and high exposure (11.9 km) threshold hydrocarbons travel from the activity area on the sea surface. This area overlaps the foraging (high annual use) BIA for pygmy blue whales and known core range of southern right whales. There is a chance that pygmy blue and southern right whales may be present in the EMBA depending on the time of year that a spill occurs. If present, these species (and other cetaceans) may be exposed to hydrocarbons. If large quantities of zooplankton exposed to the spill were ingested, chronic toxicity impacts to some individual cetaceans may occur. Biological consequences of physical contact with localised areas of high concentrations (maximum 11.9 km from the activity area) of hydrocarbons at the sea surface are unlikely to lead to any long-term population impacts. Evaporation of the hydrocarbons is expected to occur rapidly in this scenario with ~40% of the modelled 603.7 m^3 evaporating within one day of the spill occurring, thus reducing the duration of the hydrocarbons persisting on the sea surface. In comparison to the range of the BIAs of the whale species identified, the duration and extent of sea surface hydrocarbons is negligible and does not represent a long-term threat at the population level of cetaceans migrating or foraging in the EMBA. Therefore, the consequence to cetacean populations from an MDO spill is **minor**.	Impacts to cetaceans are likely to be limited to the areas of high exposure to entrained hydrocarbons. This area is predicted to be limited to central Bass Strait and only within the 0-10 m depth layer. This area overlaps the forging BIA for pygmy blue whales and known core range of southern right whales. About 42% of the MDO is expected to remain in the water column after 20 days. The pygmy blue whale BIA is for 'foraging (high annual use)' and the BIA for southern right whales is for 'known core range'. The generally low exposure threshold for entrained and low to moderate exposure for dissolved hydrocarbons encountered in the EMBA are unlikely to pose a significant threat at the population level to cetaceans given that they are likely to be migrating through the region and not undertaking critical activities such as feeding and breeding and therefore unlikely to accumulate toxic levels of hydrocarbons. Therefore, the consequence to cetacean populations from an MDO spill is **moderate**.	Not applicable.

Pinnipeds

Table 7-31: Potential risk of MDO release on pinnipeds

General sensitivity to oiling – pinnipeds	
Sensitivity rating of pinnipeds:	High
A description of pinnipeds in the EMBA is provided in:	Section 5.5.10

Pinnipeds (Australian fur-seal, New Zealand fur-seal and Australian sea lion) are potentially impacted by hydrocarbons at the sea surface, water column and shoreline.

Sea surface oil

Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water, as they need to surface every few minutes to breathe and regularly haul out on to beaches. Pinnipeds are also sensitive as they will stay near established colonies and haul-out areas, meaning they are less likely to practice avoidance behaviours. This is corroborated by Geraci and St. Aubins (1988) who suggest seals, sea-lions and fur-seals have been observed swimming in oil slicks during a number of documented spills.

Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. As a result of exposure to surface oils, pinnipeds, with their relatively large, protruding eyes are particularly vulnerable to effects such as irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Hook *et al* (2016) reports that seals appear not to be very sensitive to contact with oil, but instead to the toxic impacts from the inhalation of volatile components.

For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulative value by removing natural oils that waterproof the pelage. Consequently, the rate of heat transfer through fur seal pelts can double after oiling (Geraci & St. Aubin, 1988), adding an energetic burden to the animal. Kooyman et al (1976) suggest that in fact, fouling of approximately one-third of the body surface resulted in 50% greater heat loss in fur seals immersed in water at various temperatures. Fur-seals are particularly vulnerable due to the likelihood of oil adhering to fur. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. Davis and Anderson (1976) observed two gray seal pups drowning, their "flippers stuck to the sides of their bodies such that they were unable to swim".

However, pinnipeds other than fur-seals are less threatened by thermal effects of fouling, if at all. Oil has no effect on the relatively poor insulative capacity of sea-lion and bearded and ringed seal pelts; oiled Weddell seal samples show some increase in conductance (Oritsland, 1975; Kooyman *et al.*, 1976; 1977).

In-water oil

Ingested hydrocarbons can irritate or destroy epithelial cells that line the stomach and intestine, thereby affecting motility, digestion and absorption. However, pinnipeds have been found to have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison & Brodie, 1984; Addison *et al.*, 1986). Geraci & St. Aubin (1988) suggest that a small phocid weighing 50 kg might have to ingest approximately 1 L of oil to be at risk.

Volkman et al (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver considered likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death.

Shoreline oil

Breeding colonies (used to birth and nurse until pups are weaned) are particularly sensitive to hydrocarbon spills (Higgins & Gass, 1993). Pinnipeds are further at risk because of their tendency to stay near established colonies and haul-out areas and consequently are unlikely to practice oil avoidance behaviours.

ITOPF (2011a) report that species that rely on fur to regulate their body temperature (such as fur-seals) are the most vulnerable to oil as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil.

It is reported that most pinnipeds scratch themselves vigorously with their flippers and do not lick or groom themselves, so are less likely to ingest oil from skin surfaces (Geraci & St. Aubin, 1988). However, mothers trying to clean an oiled pup may ingest oil. All pinnipeds examined to date have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison and Brodie, 1984; Addison *et al.*, 1986).

The long-term Environmental Impact and Recovery report for the Iron Barren oil spill (in Tasmania, 1995) concluded that "The number of seal pups born at Tenth Island in 1995 was reduced when compared to previous years. There was a strong relationship between the productivity of the seal colonies and the proximity of the islands to the oil spill wherein the islands close to the spill showed reduced pup production and those islands more distant to the oil spill did not" (Tasmanian SMPC, 1999).

Pinnipeds are further at risk because they appear to rely on scent to establish a mother-pup bond (Sandegren, 1970; Fogden, 1971), and consequently oil-coated pups may not be recognisable to their mothers. This is only theorised, with studies and research indicating interaction between mothers and oiled pups were normal (Davis and Anderson, 1976; Davies, 1949; Shaughnessy & Chapman, 1984).

Australian sea-lions have 'naturally poor recovery abilities' due to 'unusual reproductive biology and life history' (TSSC, 2005). Due to the extreme philopatry of females and limited dispersal of males between breeding colonies, the removal of only a few individuals annually may increase the likelihood of decline and potentially lead to the extinction of some of the smaller colonies. Extinction of breeding colonies has the potential to further reduce genetic diversity and the already limited genetic flow between colonies. This, in turn, may weaken the genetic resilience of the species and impact on its ability to cope with other natural or anthropogenic impacts. In addition, the extreme philopatry of females suggests that extinction of breeding colonies may lead to a contraction of the range of the species as re-colonisation of breeding sites via immigration is limited.

For the reasons outlined above, small breeding colonies are under particular pressure of survival from even low levels of anthropogenic mortality.

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
The foraging range for seals may be temporarily exposed to low, moderate and high concentration of hydrocarbons at the sea surface. As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when resting at the surface. Moderate and high concentrations do not reach shorelines where seals are likely to be entering and exiting the water. Depending on the duration of time spent at the sea surface, exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Given the very small area of MDO at moderate and high exposure levels on the sea surface predicted from a single spill, as well as the rapid evaporation from the sea surface (days), acute or chronic toxicity impacts are not likely for multiple individuals. The highly mobile nature of the pinniped species likely to be present means areas on the sea surface impacted by moderate and high hydrocarbon exposure can be avoided. Given the generally brief time spent at the sea surface by pinnipeds and the rapid weathering of the MDO, the consequence of an MDO spill to multiple individuals and populations present in Bass Strait is **minor**.	Given that fur-seals forage for prey within the water column, exposure to hydrocarbons (either via ingestion of contaminated prey or direct contact with oil droplets) may occur, however the low concentrations modelled are below those likely to impart permanent injury or mortality to pinniped populations in Bass Strait. The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting the high threshold in a single spill are small in comparison to the wider area available to pinnipeds for foraging and their known range of occupation. This means there is a low probability that pinnipeds would be feeding exclusively on prey found in these areas of higher hydrocarbon thresholds for long periods of time. The area potentially affected by hydrocarbons represents a relatively small area in which fur-seals are known to forage in Bass Strait and is unlikely to be habitat critical to their survival. Because of this, the consequence to fur-seals from an MDO spill is **minor**.	Moderate and high concentrations do not reach shorelines where seals are likely to be entering and exiting the water and low threshold shoreline loading is unlikely to impart ecological harm. Therefore, the consequence of an MDO spill on pinniped species is **minor**.

Marine Reptiles

Table 7-32: Potential risk of MDO release on marine reptiles

General sensitivity to oiling – marine reptiles	
Sensitivity rating of marine reptiles:	Medium
A description of marine reptiles in the EMBA is provided in:	Section 5.5.8

Marine reptiles can be exposed to hydrocarbon through ingestion of contaminated prey, inhalation or dermal exposure (Hook *et al*., 2016).

Sea turtles are vulnerable to the effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults in nearshore waters. Several aspects of sea turtle biology and behaviour place them at particular risk, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large pre-dive inhalations. Effects of oil on turtles include increased egg mortality and developmental defects, direct mortality due to oiling in hatchlings, juveniles, and adults; and negative impacts to the skin, blood, digestive and immune systems, and salt glands. Oil exposure affects different turtle life stages in different ways. Each turtle life stage frequents a habitat with notable potential to be impacted during an oil spill. Thus, information on oil toxicity needs to be organized by life stage. Turtles may be exposed to chemicals in oil in two ways:

Internally – eating or swallowing oil, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds; and

Externally – swimming in oil or dispersants, or oil or dispersants on skin and body.

Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Short, 2011). An exception to this was the large number of marine turtles collected (613 dead and 536 live) during the Macondo spill in the GoM, although many of these animals did not show any sign of oil exposure (NOAA, 2013). Of the dead turtles found, 3.4% were visibly oiled and 85% of the live turtles found were oiled (NOAA, 2013). Of the captured animals, 88% of the live turtles were later released, suggesting that oiling does not inevitably lead to mortality.

Impacts to sea snakes during marine hydrocarbon spills are known from limited assessments, undertaken following the Montara spill in the Timor Sea in 2009. Two dead sea snakes were collected during the incident, one of which was concluded to have died as a result of exposure to the oil, with evidence of inhaled and ingested oil and elevated concentrations of PAHs in muscle tissues. The second snake showed evidence of ingestion by oil but no accumulation in tissues or damage to internal organs and it was concluded that the oil was unlikely to be the cause of death (Curtin University, 2009; 2010).

There is potential for contamination of turtle eggs to result in similar toxic impacts to developing embryos as has been observed in birds. Studies on freshwater snapping turtles showed uptake of PAHs from contaminated nest sediments, but no impacts on hatching success or juvenile health following exposure of eggs to dispersed weathered light crude (Rowe *et al*., 2009). However, other studies found evidence that exposure of freshwater turtle embryos to PAHs results in deformities (Bell *et al*., 2006, Van Meter *et al*., 2006).

Turtles may experience oiling impacts on nesting beaches and eggs through chemical exposure, resulting in decreased survival to hatching and developmental defects in hatchlings. Turtle hatchlings may be more vulnerable to smothering as they emerge from the nests and make their way over the intertidal area to the open water (AMSA, 2015). Hatchlings that contact oil residues while crossing a beach can exhibit a range of effects including impaired movement and bodily functions (Shigenaka, 2003). Hatchlings sticky with oily residues may also have more difficulty crawling and swimming, rendering them more vulnerable to predation.

Ingested oil may cause harm to the internal organs of turtles. Oil covering their bodies may interfere with breathing because they inhale large volumes of air to dive. Oil can enter cavities such as the eyes, nostrils, or mouth. Turtles may experience oiling impacts on nesting beaches when they come ashore to lay their eggs, and their eggs may be exposed during incubation, potentially resulting in increased egg mortality and/or possibly developmental defects in hatchlings.

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
Some individual marine reptiles may come into contact with low, moderate and high hydrocarbon exposure on the sea surface. At the moderate and high concentrations, toxicity impacts may occur including sub-lethal impacts including irritation of skin or cavities. However, due to the absence of turtle BIAs or critical habitat in Bass Strait and the low number of turtles foraging or migrating through Bass Strait in general, the consequence of an MDO spill to threatened turtle individuals and populations is **minor**.		There are no turtle nesting sites on the southern Victorian coast, offshore islands or Tasmanian shorelines. Thus, the consequence of an MDO spill to threatened turtle individuals and populations is **minor**.

Birds

Table 7-33: Potential risk of MDO release on seabirds and shorebirds

General sensitivity to oiling – seabirds and shorebirds	
Sensitivity rating of seabirds:	High
Sensitivity rating of shorebirds:	High
A description of seabirds and shorebirds in the EMBA is provided in:	Section 5.5.7

Seabirds and shorebirds are sensitive to the impacts of oiling, with their vulnerability arising from the fact that they cross the air-water interface to feed, while their shoreline habitats may also be oiled (Hook *et al.*, 2016). Species that raft together in large flocks on the sea surface are particularly at risk (ITOPF, 2011a).

Birds foraging at sea have the potential to directly interact with oil on the sea surface some considerable distance from breeding sites in the course of normal foraging activities. Species most at risk include those that readily rest on the sea surface (such as shearwaters) and surface plunging species such as terns and boobies. As seabirds are top order predators, any impact on other marine life (e.g., pelagic fish) may disrupt and limit food supply both for the maintenance of adults and the provisioning of young.

In the case of seabirds, direct contact with hydrocarbons is likely to foul plumage, which may result in hypothermia due to a reduction in the ability of the bird to thermo-regulate and impair water-proofing (ITOPF, 2011a). A bird suffering from cold, exhaustion and a loss of buoyancy (resulting from fouling of plumage) may dehydrate, drown or starve (ITOPF, 2011a; DSEWPC, 2011; AMSA, 2013). It may also result in impaired navigation and flight performance (Hook *et al.*, 2016). Increased heat loss as a result of a loss of water-proofing results in an increased metabolism of food reserves in the body, which is not countered by a corresponding increase in food intake, and may lead to emaciation (DSEPWC, 2011). The greatest vulnerability in this case occurs when birds are feeding or resting at the sea surface (Peakall *et al.*, 1987). In a review of 45 marine hydrocarbon spills, there was no correlation between the numbers of bird deaths and the volume of the spill (Burger, 1993).

Toxic effects of hydrocarbons on birds may result where the oil is ingested as the bird attempts to preen its feathers, and the preening process may spread the oil over otherwise clean areas of the body (ITOPF, 2011a). Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbons consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. Studies of contamination of duck eggs by small quantities of crude oil, mimicking the effect of oil transfer by parent birds, have been shown to result in mortality of developing embryos. Engelhardt (1983), Clark (1984), Geraci & St Aubin (1988) and Jenssen (1994) indicated that the threshold thickness of oil that could impart a lethal dose to some intersecting wildlife individual is 10 µm (~10 g/m^2). Scholten et al (1996) indicates that a layer 25 µm thick would be harmful for most birds that contact the slick.

Shorebirds are likely to be exposed to oil when it directly impacts the intertidal zone due to their feeding habitats. Shorebird species foraging for invertebrates on exposed sand and mud flats at lower tides will be at potential risk of both direct impacts through contamination of individual birds (ingestion or soiling of feathers) and indirect impacts through the contamination of foraging areas that may result in a reduction in available prey items (Clarke, 2010). Breeding seabirds may be directly exposed to oil via a number of potential pathways. Any direct impact of oil on terrestrial habitats has the potential to contaminate birds present at the breeding sites (Clarke, 2010). Bird eggs may also be damaged if an oiled adult sits on the nest. Fresh crude was shown to be more toxic than weathered crude, which had a medial lethal dose of 21.3 mg/egg (Clarke, 2010).

Penguins may be especially vulnerable to oil because they spend a high portion of their time in the water and readily lose insulation and buoyancy if their feathers are oiled (Hook *et al.*, 2016). The Iron Baron vessel spill (325 tonnes of bunker fuel in Tasmania in 1995) is estimated to have resulted in the death of up to 20,000 penguins (Hook *et al.*, 2016).

Potential consequence from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
There are a number of bird BIAs which overlap the MDO release area and are contacted at moderate and high thresholds (Table 7-22). The threatened bird species likely to occur in the EMBA, such as albatross and petrels, forage over an extensive area and are distributed over a wide geographic area. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with moderate to high exposure levels of MDO on the sea surface. These concentrations are generally considered detrimental to birds because of ingestion from preening of contaminated feathers, loss of thermal protection and hypothermia from matted feathers. However, rapid weathering will limit the duration of toxicity impacts. Sea surface MDO is predicted to have weathered completed after 3 days. Given the extensive ocean foraging habitat available to species such as albatross and petrel, the small area and temporary nature of the hydrocarbon release on the sea surface (<3 days) makes it unlikely that a spill will limit their ability to forage for unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. Therefore, the consequence to seabirds from an MDO spill is **moderate**.	The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting the high threshold during an MDO spill are relatively small in comparison to the wider Bass Strait region. It is these small areas where sub-lethal or toxic effects to birds may occur. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these areas of higher hydrocarbon thresholds, meaning there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. Therefore, the consequence to seabirds from an MDO spill is **minor**.	The average length of shoreline predicted to be exposed to MDO that may have ecological impacts to birds (100 g/m^2) is 10.1 km during summer and 4.6 km during winter, with an average volume of 3.7 m^3 during summer and 5.3 m^3 during winter. There is a 6% probability of contact with moderate threshold exposure to shorelines at King Island and 1-2% probability of contact on the Victorian coast near Cape Otway and near Port Campbell. These sections of coastline comprise mostly rocky shores that do not provide suitable habitat for beach nesting species such as hooded plovers, terns, snipes and sandpipers. MDO is unlikely to persist on the surface of these rocky shores that are exposed to high energy wave action in Bass Strait. Shorebirds foraging for food in intertidal areas or along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering the sandy nests of hooded plovers, terns or other bird species (in areas not exposed to shoreline loading) is likely to percolate through the sand and not accumulate in the feathers of adults or young. Toxicity effects from ingestion of contaminated prey caught in the intertidal zone or from direct exposure or transport back to nests are unlikely to occur, as the volatile components are likely to have weathered prior to stranding. The populations of shorebird species within the EMBA have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other un-impacted locations. Due to isolated areas of moderate shoreline loading, the consequence of an MDO spill to shorebird species is **moderate**.
This hydrocarbon spill scenario will not have a 'significant' impact on migratory shorebird species (see Section 5.4.4) when assessed against the EPBC Act *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act-listed migratory shorebird species Policy Statement 3.21* (DoEE, 2017b), which are:		
Loss of habitat.	The sandy beaches of the EMBA will not be lost in the event of an MDO spill.	
Degradation of habitat leading to a substantial reduction in migratory shorebird numbers.	Shoreline quality will temporarily decrease but given the behaviour of MDO and nature of the shoreline, there will be no long-term degradation.	

Increased disturbance leading to a substantial reduction in migratory shorebird numbers.	MDO will rapidly percolate through sandy beach sediments, resulting in only short-term disturbance. The most likely shoreline response option will be to monitor and evaluate (rather than actively undertake a clean-up), further reducing the potential for disturbance to shorebirds.
Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers.	Depending on the nature of the spill, how it weathers and the location of shoreline loading, there is a low risk of direct mortality of birds. No one area of the EMBA, particularly the shoreline closest to the survey area, has high concentrations or a high percentage of a population of any migratory shorebird species. As such, a substantial reduction in migratory shorebird numbers is highly unlikely to occur.
This hydrocarbon spill scenario will not have a 'significant' impact on threatened seabird species (see Section 5.4.4) when assessed against the EPBC Act *Significant Impact Guidelines 1.1* (DoE, 2013), which are:	
Lead to a long-term decrease in the size of a population.	A spill would not lead to a long-term decrease in the size of a population given the small area of 'swept ocean' from a single spill, the rapid weathering of MDO and the low likelihood of a large portion of a seabird population being present in the spill area at any one time.
Reduce the area of occupancy of the species.	Given the small area of 'swept ocean' from a single spill, the rapid weathering of MDO and the abundance of suitable nearby habitat, sea surface water quality will temporarily decrease and therefore the area of occupancy will be temporarily reduced but there will be no long-term reduction in the area of occupancy.
Fragment an existing population into two or more populations.	In the event of an MDO spill, seabirds have access to an expansive area of unpolluted waters. A spill would not fragment an existing population given the small area of 'swept ocean' from a single spill.
Adversely affect habitat critical to the survival of a species.	The marine waters of the survey area and EMBA are not critical to the survival or any seabirds. Similar marine habitat occurs all through Bass Strait and the Southern Ocean.
Disrupt the breeding cycle of a population.	Most of the seabird species known to occur in the survey area and EMBA (e.g., albatross, petrels, shearwaters) breed outside of Australia or well beyond the EMBA. Given the small area of 'swept ocean' from a single spill and the rapid weathering of MDO, it is highly unlikely that the breeding cycle of a seabird population will be disrupted.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Given the small area of 'swept ocean' from a single spill and the rapid weathering of MDO, the quality of marine waters in the area of the spill will be temporarily reduced. However, marine habitat will not be modified, destroyed, removed, isolated or decreased to the extent that one or more seabird species will decline. Most of the seabird species known to occur in the survey area and EMBA (e.g., albatross, petrels, shearwaters) breed outside of Australia or well beyond the EMBA. This being the case, it is unlikely for adults to bring contaminated prey back to nests to feed chicks. For the species that do breed in Australian waters and parts of the EMBA, it is unlikely that MDO or MDO-affected prey would be brought back to the nest in quantities significant enough to result in mortality of chicks and the loss of a generation.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	There are several EPBC Act-listed endangered and critically endangered seabirds that may occur in the survey area and/or EMBA. An MDO spill is highly unlikely to result in the introduction and spread of IMS that are harmful to these species. Vessels that may be involved in the 'monitor and evaluate' spill response strategy will be subject to strict IMS controls to ensure that ballast water is of 'low risk' and that hulls are free of IMS.

Introduce disease that may cause the species to decline.	The risks of toxic impacts to individual birds or populations is minor due to the rapid weathering of MDO. The small extent of a single spill further reduces the risk to a small area. As such, it is unlikely that there would be a large number of 'oiled' birds that may then become susceptible to disease.
Interfere with the recovery of the species.	For all the reasons outlined above, an MDO spill will not interfere with the recovery of a seabird species.

The activity will not impact on the objectives of the Draft Wildlife Conservation Plan for Seabirds (DAWE, 2019), which are:

International cooperation and collaboration occur to support the survival of seabirds and their habitats outside Australian jurisdiction.

Seabirds and their habitats are protected and managed in Australia.

The long-term survival of seabirds and their habitats is achieved through supporting priority research programs, coordinating monitoring, on-ground management and conservation.

Awareness of the importance of conserving seabirds and their habitats is increased through a strategic approach to community education and capacity building to support monitoring and on-ground management.

Formally managed shorebird species with oil spills listed as a threat include the red knot, lesser sand plover, bar-tailed godwit (northern Siberian), Australian fairy tern and the hooded plover (eastern). There are no specific management actions in the conservation advice for the red knot, lesser sand plover or bar-tailed godwit (northern Siberian) regarding oil spills.

An assessment is provided below where there are specific management actions relating to oil spills for the Australian fairy tern and the hooded plover (eastern).

Australian fairy tern	
Management Action: Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills, such as the breeding colonies in Victoria.	**Assessment:** An OPEP has been prepared for the activity that includes actions to reduce the extent and spread of oil on the sea surface. The OSTM undertaken indicates that shoreline loading above the minimum reporting threshold will not occur along the Victorian coastline. Therefore, the activity will be undertaken in a manner that is not inconsistent with the management action.
Hooded plover (eastern)	
Management Action: Prepare oil spill response plans to ensure effective rehabilitation of oiled birds.	**Assessment:** An OPEP has been prepared for the activity that includes actions to reduce the extent and spread of oil on the sea surface. The OSTM undertaken indicates that shoreline loading above the minimum reporting threshold will not occur where hooded plovers are known to occur (sandy beaches of the Victorian coastline). Therefore, the activity will be undertaken in a manner that is not inconsistent with the management action.

Beaches

Table 7-34: Potential risk of MDO release on sandy beaches

General sensitivity to oiling – sandy beaches	
Sensitivity rating of sandy beaches (environmental):	Low
Sensitivity rating of sandy beaches (socio-economic):	Medium
A description of sandy beaches in the EMBA is provided in:	Section 5.5.1

Sandy beaches are regularly exposed to wave action and have low sediment total organic carbon and therefore generally a low abundance of marine life (Hook *et al*., 2016). The low concentration of total organic carbon and large particle size of sand means that any MDO deposited on the beach would not be retained. However, sandy beaches are important socio-economically, so an MDO spill reaching this type of shoreline may attract attention that is disproportionate to its sensitivity (Hook *et al*., 2016).

Depth of penetration in sandy sediment is influenced by:

- Particle size - penetration is great in coarser sediments (such as beach sand) compared to mud (in estuaries and tidal flats).
- Oil viscosity – MDO quickly penetrates sandy sediments.
- Drainage – coarse beach sands allow for rapid drainage (it may reach depths greater than one metre in coarse well-drained sediments).
- Animal burrows and root pores - penetration into fine sediments is increased if there are burrows of animals such as worms, or pores left where plant roots have decayed.

Areas of heavy oiling (>1,000 g/m^2 threshold) would likely result in acute toxicity, and death, of many invertebrate communities, especially where oil penetrates into sediments through animal burrows (IPIECA, 1999). However, these communities would be likely to rapidly recover (recruitment from unaffected individuals and recruitment from nearby areas) as oil is removed from the environment. The results of exposure to oil may be acute (e.g., die off of amphipods and replacement by more tolerant species such as worms or chronic (i.e., gradual accumulation of oil and genetic damage) (Hook *et al*., 2016).

For example, following the Sea Empress spill (in west Wales, 1996) many amphipods (sandhoppers), cockles and razor shells were killed. There were mass strandings on many beaches of both intertidal species (such as cockles) and shallow sub-tidal species. Similar mass strandings occurred after the Amoco Cadiz spill (in Brittany, France, 1978) (IPIECA, 1999). Following the Sea Empress spill, populations of mud snails recovered within a few months but some amphipod populations had not returned to normal after one year. Opportunists such as some species of worm may actually show a dramatic short-term increase following an oil spill (IPIECA, 1999). Long-term depletion of sediment fauna could have an adverse effect on birds or fish that use tidal flats as feeding grounds (IPIECA, 1999).

In March 2014, small volumes of crude oil from an unidentified source (confirmed to not be offshore oil and gas production facilities) washed up along a 7-km section of sandy beach on the Victorian Gippsland coast as small (a few millimetres thick) granular balls (Gippsland Times, 2014; ABC News, 2014). AMSA (2014b) reported that no impacts were observed over the course of two months following the incident.

The Macondo well blowout resulted in oil washing up on sandy beaches of the Alabama coastline. The natural movement of sand and water through the beach system continually transformed and re-distributed oil within the beach system, and 18 months after the event, mobile remnant oil remained in various states of weathering buried at different depths in the beaches (Hayworth *et al*., 2011). Other results from beach sampling undertaken at Dauphin Island, Alabama, in May (pre-impact) and September 2011 (post-impact) found a large shift in the diversity and abundance of microbial species (e.g., nematodes, annelids, arthropods, polychaetes, protists, fungi, algae and bacteria). Post-spill, sampling indicated that species composition was almost exclusively dominated by a few species of fungi. DNA analyses revealed that the 'before' and 'after' communities at the same sites weren't closely related to each other (Bik *et al*., 2012). Similar studies found that oil deposited on the beaches caused a shift in the community structure toward a hydrocarbonoclastic consortium (petroleum hydrocarbon degrading microorganisms) (Lamendella *et al*., 2014).

Potential consequence from MDO release
Shoreline
No MDO shoreline loading at the high threshold is predicted in the OSTM. During the summer conditions, King Island was the only shoreline receptor that was predicted to have shoreline accumulation above the low threshold (10 g/m^2) with a probability of low accumulation of 8%. The minimum time before shoreline accumulation at King Island during summer conditions was 6.67 days, whilst the maximum shoreline accumulation volume was 27.6 m^3 during summer conditions. During winter conditions the minimum time for low threshold shoreline accumulation was 3.25 days predicted for the Colac Otway region, whilst the maximum shoreline accumulation volume was predicted to occur at King Island (24.6 m^3). Sandy beaches in these areas are mostly exposed and subject to strong wave action. While MDO penetrates porous sediments (e.g., sand) quickly, it is also washed off quickly (and weathered within sediments) by waves (NOAA, 2012), thus minimising impacts to intertidal fauna. This would assist in natural degradation of MDO. Areas of low exposure to shoreline loading are not expected to exhibit environmental harm. Due to the exposed nature of the shoreline and the nature of MDO, long-term toxicity or smothering effects in areas of moderate MDO exposure are not expected and natural weathering should be sufficient to aid in recovering communities rapidly. Shorelines that may be exposed to low and moderate threshold loading are located on offshore islands in Bass Strait, the largest of which is Hunter Island. In general, these islands are sparsely inhabited or uninhabited. Therefore, socio-economic and environmental consequences from shoreline loading are **minor**.

Rocky Shores

Table 7-35: Potential risk of MDO release on rocky shores

General sensitivity to oiling – rocky shores	
Sensitivity rating of rocky shores (environmental):	Low
Sensitivity rating of rocky shores (socio-economic):	Medium
A description of rocky shores in the EMBA is provided in:	Section 5.5.1
Cracks and crevices, rock pools, overhangs and other shaded areas provide habitat for soft bodied animals such as sea anemones, sponges and sea-squirts, and become places where hydrocarbons can become concentrated as it strands ashore. The same is true on stable boulder shores where the rich animal communities underneath the rocks are also the most vulnerable to hydrocarbon pollution. The vulnerability of a rocky shoreline to oiling is dependent on its topography and composition as well as its position. A vertical rock wall on a wave-exposed coast is likely to remain unoiled if an oil slick is held back by the action of the reflected waves. At the other extreme, a gradually sloping boulder shore in a calm backwater of a sheltered inlet can trap enormous amounts of hydrocarbons, which may penetrate deep down through the substratum. The complex patterns of water movement close to rocky coasts also tend to concentrate oil in certain areas. Some shores are well known to act as natural collection sites for litter and detached algae and oil is carried there in the same way. As on all types of shoreline, most of the oil is concentrated along the high tide mark while the lower parts are often untouched (IPIECA, 1995). It is not long before the waves and tides that carried the hydrocarbons onto the shore gradually remove it again, but the rate of such weathering is dependent on many factors. The wave exposure, weather conditions and the shore characteristics are most important. For example, a patch of oil on a rock exposed to heavy wave action is not going to remain there for long. However, it could take many years for the limited water movement in a sheltered bay to remove oil trapped under boulders or in gullies and crevices. Gradual leaching of this oil could result in constant low-level pollution of, for example, a rock pool. Microbial breakdown of the oil is slower in cold or temperature environments than sub-tropical or tropical environments. The presence of silt and clay particles can assist with oil removal by the process of flocculation. Grazing animals such as marine snails may also remove significant amounts of oil. As the oil is weathered it becomes more viscous and less toxic, often leaving little but a small residue of tar on upper shore rocks. This residue can remain as an unsightly stain for a long time but it is unlikely to cause any more ecological damage. Oil tends not to remain on wet rock or algae but is likely to stick firmly if the rock is dry (IPIECA, 1995).	
Potential consequence from MDO release	
Shoreline	
Rocky shores intersected by MDO at the low exposure threshold are not likely to experience ecological impact. Potential impacts arising from a MDO spill on the ecological, tourism, cultural and/or social values of rocky shores are more likely to occur than ecological impacts at low threshold exposure to MDO. No MDO shoreline loading at the high threshold is predicted in the OSTM.During the summer conditions, King Island was the only shoreline receptor that was predicted to have shoreline accumulation above the low threshold (10 g/m^2) with a probability of low accumulation of 8%. The minimum time before shoreline accumulation at King Island during summer conditions was 6.67 days, whilst the maximum shoreline accumulation volume was 27.6 m^3 during summer conditions. During winter conditions the minimum time for low threshold shoreline accumulation was 3.25 days predicted for the Colac Otway region, whilst the maximum shoreline accumulation volume was predicted to occur at King Island (24.6 m^3). Much of these coastlines are comprised of rocky shores with cliffs, shore platforms and pebble/boulder beaches. The action of reflected waves off rocky shores, together with the predicted weathering of the MDO, means it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline. The MDO is likely to be continually washed off the substrate and into the water, leading to further weathering. Therefore, the consequence of an MDO spill on rocky shores is **minor**.	

Fisheries

Table 7-36: Potential risk of MDO spill on commercial fisheries

General sensitivity to oiling – commercial fishing	
Sensitivity rating of commercial fisheries:	High
A description of commercial fisheries operating in the EMBA is provided in:	Section 5.6.7

Commercial fishing has the potential to be impacted through exclusion zones associated with the spill, the spill response and subsequent reduction in fishing effort. Exclusion zones may impede access to commercial fishing areas, for a short period of time, and nets and lines may become oiled. The impacts to commercial fishing from a public perception perspective however, may be much more significant and longer term than the spill itself.

Fishing areas may be closed for fishing for shorter or longer periods because of the risks of the catch being tainted by oil. Concentrations of petroleum contaminants in fish, crustacean and mollusc tissues could pose a significant potential for adverse human health effects, and until these products from nearshore fisheries have been cleared by the health authorities, they could be restricted for sale and human consumption. Indirectly, the fisheries sector will suffer a heavy loss if consumers are either stopped from using or unwilling to buy fish and shellfish from the region affected by the spill.

Impacts to fish stocks have the potential for reduction in profits for commercial fisheries, and exclusion zones exclude fishing effort. Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm.

The Montara spill (as the most recent [2009] example of a large hydrocarbon spill in Australian waters) occurred over an area fished by the Northern Demersal Scalefish Managed Fishery (with 11 licences held by 7 operators), with goldband snapper, red emperor, saddletail snapper and yellow spotted rockcod being the key species fished (PTTEP, 2013). As a precautionary measure, the WA Department of Fisheries advised the commercial fishing fleet to avoid fishing in oil-affected waters. Testing of fish caught in areas of visible oil slick (November 2009) found that there were no detectable petroleum hydrocarbons in fish muscle samples, suggesting fish were safe for human consumption. In the short-term, fish had metabolised petroleum hydrocarbons. Limited ill effects were detected in a small number of individual fish only (PTTEP, 2013). No consistent effects of exposure on fish health could be detected within two weeks following the end of the well release. Follow up sampling in areas affected by the spill during 2010 and 2011 (PTTEP, 2013) found negligible ongoing environmental impacts from the spill.

Since testing began in the month after the Macondo well blowout in the Gulf of Mexico (GoM) (2010), levels of oil contamination residue in seafood consistently tested 100 to 1,000 times lower than safety thresholds established by the USA FDA, and every sample tested was found to be far below the FDA's safety threshold for dispersant compounds (BP, 2015). FDA testing of oysters found oil contamination residues to be 10 to 100 times below safety thresholds (BP, 2014). Sampling data shows that post-spill fish populations in the GoM since 2011 were generally consistent with pre-spill ranges and for many shellfish species, commercial landings in the GoM in 2011 were comparable to pre-spill levels. In 2012, shrimp (prawn) and blue crab landings were within 2.0% of 2007-09 landings. Recreational fishing harvests in 2011, 2012 and 2013 exceeded landings from 2007-09 (BP, 2014).

In the event of a MDO spill, a temporary fisheries closure may be put in place by AFMA, the VFA and/or DPIPWE (or voluntarily by the fishers themselves). Oil may foul the hulls of fishing vessels and associated equipment, such as gill nets. A temporary fisheries closure, combined with oil tainting of target species (actual or perceived), may lead to financial losses to fisheries and economic losses for individual licence holders. Fisheries closures and the flow on losses from the lack of income derived from these fisheries are likely to have short-term but widespread socio-economic consequences, such as reduced employment (in fisheries service industries, such as tackle and bait supplies, fuel, marine mechanical services, accommodation and so forth).

Potential consequence from MDO release			
Fishery	**Surface oiling**	**Water column**	**Shoreline**
General	A short-term fishing exclusion zone may be implemented by AFMA, the VFA and/or DPIPWE. Given the temporary nature of any surface slick and the low fishing intensity in the EMBA, there are unlikely to be any significant impact on fisheries in terms of lost catches (and associated income).	OSTM predicts large areas may be exposed to dissolved and entrained hydrocarbons at the low exposure threshold, and smaller areas at the moderate dissolved and high entrained exposure thresholds. Note, the high exposure threshold for dissolved hydrocarbons was not reached. A short-term fishing exclusion zone may be implemented by AFMA or the Victorian or Tasmanian fishing authorities. The areas of moderate dissolved and high entrained exposure thresholds represent small areas available to commercial fishing. The hydrocarbons are predicted to weather quickly and the area would return to pre-spill conditions rapidly.	Vessels use local ports, some of which are included within the EMBA. Where the EMBA intersects moored fishing vessels, some staining or coasting of vessel hulls may occur.
Victorian fisheries (those known to fish within the EMBA)			
Scallop	No impacts due to their benthic habitat.	Hydrocarbons are not expected to accumulate among benthic sediments in areas fished for scallops. A temporary closure of the area affected by hydrocarbons may be implemented. Therefore, this is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	As per 'general'.
Abalone	No impacts due to their benthic habitat.	The most heavily fished areas of the fishery are located off the east coast of Victoria. Much of the fishery is exposed to areas of low threshold entrained hydrocarbons, which will not result in sub-lethal or lethal impacts to the target species. A temporary closure of the area affected by hydrocarbons may be implemented. This is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	As per 'general'.
Rock lobster	There is a low risk of rock lobster pot buoys accumulating hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned. This is expected to be of **minor** consequence to the fishery.	The OSTM indicates the maximum extent of high exposure of the benthic layer to entrained hydrocarbons occurs in the nearshore environment around Cape Otway. Low exposure entrained hydrocarbons intersect large areas of the fishery, which will not result in sub-lethal or lethal impacts to the target species. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until	As per 'general'.

		water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	
Giant crab	There is a low risk of crab pot buoys accumulating hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned. This is expected to be of **minor** consequence to the fishery.	The OSTM indicates the maximum extent of high exposure of the benthic layer to entrained hydrocarbons occurs in the nearshore environment around Cape Otway. Low exposure entrained hydrocarbons intersect large areas of the fishery, which will not result in sub-lethal or lethal impacts to the target species. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	As per 'general'.
Wrasse	No impacts due to their pelagic habitat.	Low exposure to entrained and dissolved hydrocarbons intersect large areas of the wrasse fishery, which will not result in sub-lethal or lethal impacts to the target species. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	As per 'general'.
Ocean purse seine	No impacts due to their pelagic habitat.	This fishery has access to the entire Victorian coastline (except for bays and reserves), so some areas of the available fishing grounds are exposed to low threshold entrained MDO. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of **minor** consequence to the overall function of the fishery, its catch species and its future viability.	As per 'general'.
Ocean access			As per 'general'.

Tasmanian fisheries (those known to fish within the EMBA)			
Scalefish	No impacts due to their pelagic habitat.	A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery or its catch species and the consequence of the MDO spill is therefore **minor**.	As per 'general.'
Giant crab	No impacts due to their benthic habitat. There is a low risk of giant crab pot buoys accumulating hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned. This is expected to be of **minor** consequence to the fishery.	Hydrocarbons are not expected to accumulate among benthic sediments in the EMBA due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column. A temporary closure of the area affected by hydrocarbons may be implemented though this is not expected to impact on the overall function of the fishery, its catch species or its future viability. Therefore, the short- or long-term consequence to the fishery or its catch species is **minor**.	As per 'general.'
Southern rock lobster	No impacts due to their benthic habitat. There is a low risk of rock lobster pot buoys accumulating hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned. This is expected to be of **minor** consequence to the fishery.	Hydrocarbons are not expected to accumulate among benthic sediments in the EMBA due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column. A temporary closure of the area affected by hydrocarbons may be implemented though this is not expected to impact on the overall function of the fishery, its catch species or its future viability. Therefore, the short- or long-term consequence to the fishery or its catch species is **minor**.	As per 'general.'
Octopus	No impacts due to their benthic and pelagic habitat. There is a low risk of octopus pot buoys accumulating hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned. This is expected to be of **minor** consequence to the fishery.	A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery or its catch species and the consequence of the MDO spill is therefore **minor**.	As per 'general.'
Abalone	No impacts due to their benthic habitat.	Hydrocarbons are not expected to accumulate among benthic sediments in the EMBA due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column.	As per 'general.'

		A temporary closure of the area affected by hydrocarbons may be implemented though this is not expected to have a significant impact on the overall function of the fishery or its catch species. Therefore, the short- or long-term consequence to the fishery or its catch species is **minor**.	
Commercial dive	No impacts due to their benthic habitat.	A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery or its catch species and the consequence of the MDO spill is therefore **minor**.	As per 'general.'
Commonwealth fisheries (those known to fish within the EMBA)			
Scallop	No impact due to their benthic habitat.	Hydrocarbons are not expected to accumulate among benthic sediments in the EMBA due to the significant mixing of waters and dilution of the high and low concentration of hydrocarbons in the water column. The most intensely fished areas of the fishery, off the east coast of King Island in Commonwealth waters, are not exposed to dissolved hydrocarbons in the benthic layer, however they are exposed to low levels of entrained hydrocarbons. However, a temporary closure of the area affected by hydrocarbons may be implemented until background water quality levels return to pre-spill conditions. Given the proximity of recent fishing effort to the survey area, the consequence of a hydrocarbon spill and potential closure of grounds adjacent the spill would be of **moderate** consequence to the fishery.	Not applicable.
Southern squid jig	The most heavily fished areas of the fishery are located off the west coast of Victoria and east coast of Tasmania, which are not exposed to hydrocarbons. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery, its catch species or its future viability. Therefore, the consequence of the MDO spill is therefore **minor**.		Not applicable.
SESS – gillnet and shark hook sector	The most heavily fished areas of the fishery are located off the east coast of Victoria and north coast of Flinders Island, which are not exposed to surface oil and exposed to low exposure thresholds for entrained hydrocarbons, which will not result in sub-lethal or toxicity impacts to target species. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery, its catch species or its future viability. Therefore, the consequence of the MDO spill is therefore **minor**.		Not applicable.

SESS – Commonwealth trawl sector	The most heavily fished areas of the fishery are located on the continental slope off the east coast of Victoria, southwest Victoria and the west and east coasts of Tasmania. These areas are not exposed to surface oil and exposed to low exposure thresholds for entrained hydrocarbons, which will not result in sub-lethal or lethal impacts to target species. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have an impact on the overall function of the fishery, its catch species or its future viability. Therefore, the consequence of the MDO spill is therefore **minor**.	Not applicable.
SESS - scalefish hook sector	The most heavily fished areas of the fishery are located off the east coast of Tasmania, which is outside the EMBA. The area affected by hydrocarbons is among the least intensely fished area for the fishery. A temporary closure of the area affected by hydrocarbons may be implemented This is not expected to have an impact on the overall function of the fishery, its catch species or its future viability. Therefore, the consequence of the MDO spill is therefore **minor**.	Not applicable.

7.16.6 Risk Assessment

Table 7-37 presents the risk assessment for an MDO spill.

Table 7-37: Risk assessment for an MDO spill

Summary			
Summary of risks	Localised and temporary reduction in water quality. Potential toxicity impacts to marine life. Temporary fisheries closures.		
Extent of risks	EMBA is defined in Section 7.16.4.		
Duration of risks	Short-term (several days, depending on level of contact, location and receptor).		
Level of certainty of risks	HIGH –the environmental impacts of spilled hydrocarbons are well understood.		
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.		
Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Highly unlikely	Low
Macroalgal communities	Minor	Highly unlikely	Low
Plankton	Minor	Highly unlikely	Low
Fish	Minor	Highly unlikely	Low
Cetaceans	Moderate	Highly unlikely	Low
Pinnipeds	Minor	Highly unlikely	Low
Marine reptiles	Minor	Highly unlikely	Low
Seabirds	Moderate	Highly unlikely	Low
Shorebirds	Moderate	Highly unlikely	Low
Sandy beaches	Minor	Highly unlikely	Low
Rocky shores	Minor	Highly unlikely	Low
Commercial fisheries	Minor	Highly unlikely	Low

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Preventative controls as per 'displacement of or interference with third-party vessels' and 'routine emissions – light.' Additional controls are provided here.		
Preparedness		
Heavy fuel oil is not used by the CSV.	Only MDO fuel is used by the CSV.	Bunker log verifies that the fuel is MDO.
No MDO is spilled at sea during refuelling activities	Refuelling activities shall be undertaken in accordance with the vessel contractor Bunkering Procedure in order to prevent an MDO spill	Bunker record verifies vessel bunkering procedures were implemented.

(if required – refuelling at sea is a contingency only).	during vessel-to-vessel transfers, including but not limited to the following:	
	A job safety analysis (JSA) and permit to work (PTW) is completed and signed off for each bunkering event.	JSA and PTW records indicate that spill requirements were accounted for during bunkering.
	Dry-break couplings on refuelling hoses (including floats installed on refuelling hoses) for bulk transfer of MDO during refuelling.	Pre-mobilisation audit records verify that dry break refuelling house couplings and hose floats are installed on the refuelling hose assembly.
	All transfer equipment (hoses, pumps) will be maintained in accordance with manufacturer's instructions via the vessel's Planned Maintenance System (PMS) and inspected prior to use to eliminate leaks during transfer.	PMS and task inspection records verify refuelling equipment is fit for purpose.
	Tank level indicators and level alarms are provided for in the vessel control room for bunkering tanks.	Pre-refuelling checklist confirmed the tank level alarms are functional.
	Vessel refuelling is undertaken during daylight hours.	Bunker log verifies that refuelling was undertaken during daylight hours.
	Communications (visual and audio) between relevant vessel personnel is tested prior to commencement of bunkering.	Bridge log indicates communications were tested during vessel-to-vessel transfer.
	Bunkering operation is supervised at all times by trained and experienced personnel.	Training records verify that personnel are trained and experienced in bunkering operations.
No MDO is spilled at sea as a result of vessel-to-vessel collision.	In order to minimise the risk of vessel-to-vessel collisions, the CSV will: Comply with the requirements of: *Navigation Act 2012* (Cth), Chapter 3, Part 3 (Seaworthiness of vessels). Marine Order 21 (Safety and emergency arrangements). Marine Order 30 (Prevention of Collisions). Marine Order 91 (Marine pollution prevention - oil). Operate navigational lights and communication systems. Maintain navigational lights and communication systems in accordance with their PMS. Have trained and competent crew maintaining 24-hour visual, radar and radio watch for other vessels.	Vessel audit/assurance reports (prepared or commissioned by Beach) verify that vessels contracted to Beach meet legislative safety requirements.
	AMSA is notified within two weeks of the commencement of the activity so that a Notice to Mariners can be generated.	Notice to Mariners is available in time for the commencement of the activity.
	Beach notifies relevant stakeholders ahead of the activity so that third-party marine users are aware of vessel location and timing.	Stakeholder correspondence and the stakeholder register verify that Beach made contact with relevant stakeholders about the timing and location of the activity.
		Current SMPEP is available.

Vessel crews are prepared to respond to a spill.	An approved SMPEP is implemented in the event of a large MDO spill.	Spill incident report verifies that the actions were taken in accordance with the SMPEP.
	Vessel crew is trained in spill response techniques in accordance with their SMPEP.	Training records verify that crews are trained in spill response.
	In accordance with the SMPEP, oil spill response kits are available in relevant locations around the vessel, are fully stocked and are used in the event of hydrocarbon or chemical spills to deck.	Inspection/audit confirms that SMPEP kits are readily available on deck.
		Incident reports for hydrocarbon spills to deck record that the spill is cleaned up using SMPEP resources.
	Prior to the activity commencing, a desktop oil spill response exercise is conducted to test the interfaces between the Beach OPEP, ERP and vessel contractor SMPEP.	Oil spill response exercise spreadsheet verifies that exercises have been undertaken.
Emergency response		
Vessel crews promptly respond to a spill.	An OPEP and ERP are in place and tested annually in desktop exercises by those nominated in the plans to be part of the response strategies.	The OPEP and ERP are current.
		OPEP and ERP training schedule is available and remains live.
		The training matrix is maintained as a live document and verifies that personnel nominated to assist in emergency response are up to date with their training.
		OPEP and ERP exercise reports verify that exercises have been undertaken.
	The Vessel Master will authorise actions in accordance with the vessel-specific SMPEP (or equivalent according to class).	Daily operations reports verify that the SMPEP was implemented.
	The OPEP is implemented to limit the release of a Level 2 or 3 MDO spill.	Daily operations reports verify that the OPEP was implemented.
Recording and reporting		
Beach and regulatory authorities are promptly made of aware of near-misses and spills.	All incidents of spatial conflict with other marine users will be reported in the Beach incident register (CMO).	The CMO is current.
	Beach will report the spill to regulatory authorities within 2 hours of the spill or becoming aware of the spill.	Incident report verifies that contact with regulatory agencies was made within 2 hours.
Monitoring		
Characterise environmental impacts of a Level 2 or 3 spill.	Beach will undertake operational and scientific monitoring in accordance with the OSMP.	Daily operations reports and overall study reports verify that the OSMP was implemented.

Risk Assessment (residual)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Remote	Low
Macroalgal communities	Minor	Remote	Low
Plankton	Minor	Remote	Low
Pelagic fish	Minor	Remote	Low

<table>
<tr><td>Cetaceans</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><td>Pinnipeds</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><td>Marine reptiles</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><td>Seabirds</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><td>Shorebirds</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><td>Sandy beaches</td><td colspan="2">Minor</td><td>Highly unlikely</td><td>Low</td></tr>
<tr><td>Rocky shores</td><td colspan="2">Minor</td><td>Highly unlikely</td><td>Low</td></tr>
<tr><td>Commercial fisheries</td><td colspan="2">Minor</td><td>Remote</td><td>Low</td></tr>
<tr><th colspan="5">Demonstration of ALARP</th></tr>
<tr><td colspan="5">A ‘low’ residual risk rating is considered to be ALARP and a ‘lower order’ impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of ‘B’, an ALARP analysis is presented below.</td></tr>
<tr><td colspan="5">Good practice</td></tr>
<tr><td>Avoid/Eliminate</td><td colspan="4">The potential for a vessel collision leading to a MDO spill cannot be eliminated completely.
However, eliminating the need to refuel on location removes one of the more credible sources of an MDO spill.</td></tr>
<tr><td>Change the likelihood</td><td colspan="4" rowspan="2">Power that could be used as a substitute to MDO, such as solar or wind power or biofuels, are not commercially proven in vessels. MDO is a substitute for HFO, which would have greater environmental impacts if spilled.
Other measures in place to reduce the likelihood and consequence of an MDO spill are that vessels are equipped with navigation aids, are equipped with dynamic positioning and are manned by qualified and experienced personnel.</td></tr>
<tr><td>Change the consequence</td></tr>
<tr><td>Reduce the risk</td><td colspan="4">A vessel-specific SMPEP is in place and implemented.
The ERP and OPEP are implemented in the event of a Level 2 or 3 spill.</td></tr>
<tr><td colspan="5">Engineering risk assessment</td></tr>
<tr><td colspan="5">The OSTM undertaken for the MDO spill scenario is an engineering risk assessment and supports the development of the EPS listed in this table.</td></tr>
<tr><td colspan="5">Cost benefit analysis</td></tr>
<tr><td colspan="5">Not applicable for an impact decision framework context of ‘B’.</td></tr>
<tr><th colspan="5">Demonstration of Acceptability</th></tr>
<tr><td rowspan="2">Internal context</td><td>Policy compliance</td><td colspan="3">Beach Environmental Policy objectives are met through implementation of this EP.</td></tr>
<tr><td>OEMS compliance</td><td colspan="3">Chapter 8 describes the EP implementation strategy employed for this activity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="4">Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with the activity.
There has been no concern expressed by relevant persons about MDO spills for this activity.</td></tr>
<tr><td>Legislative context</td><td colspan="4">The performance standards outlined in this EP align with the requirements of:
Navigation Act 2012 (Cth):
Chapter 4 (Prevention of Pollution).
OPGGS Act 2006 (Cth):
Section 572A-F (Polluter pays for escape of petroleum).
OPGGS(E):
Part 3 (Incidents, reports and records).</td></tr>
</table>

	Protection of the Sea (Prevention of Pollution by Ships) Act 1983 (Cth): Section 11A (SOPEP). *Environment Protection Act* 1993 (SA); *Pollution of Waters by Oil and Noxious Substances Act* 1987 (Tas); *POWBONS Act* 1986 (Vic) • Section 10 (Duty to report certain incidents involving oil and oily mixtures).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this activity are in line with the management measures listed for spills from vessels in Section 4.7.2 of the guidelines: • Vessels having a SMPEP. • Vessels having radar fitted and maintaining appropriate lighting and navigation systems. • Having safety exclusion zones around facilities.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding preventing or managing an offshore MDO spill, other than having a spill contingency plan in place. An OPEP is in place for the activity.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: Section 75 (Spills): Conducting a spill risk assessment, implementing personnel training and field exercises, ensuring spill response equipment is available. Sections 76-79 (Spill response planning): A spill response plan should be prepared.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the risk of any unplanned release of material into the marine environment to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	The MDO EMBA intersects the following AMPs: Apollo; and Beagle. These AMPs have the following relevant conservation values: - Benthic assemblages. - Cetaceans. - Seabirds. - Pinnipeds. - White shark. **As addressed in Benthic assemblages** Table 7-26 through Table 7-36, the consequence of an MDO spill on these receptors is minor and unlikely to result in long-term ecological impacts.
	Wetlands of international importance	There is a low probability of low exposure entrained hydrocarbons intersecting small portions of the Western Port and Port Phillip Bay (Western Shoreline) and Lavinia Ramsar sites. At this exposure concentration, the values of these wetlands will not be affected in the long-term.
	TECs	Entrained hydrocarbons at the low threshold of exposure may intersect the Giant Kelp Forests of South East Australia.

		At this exposure level, there will be no significant impacts to giant kelp populations.
	NIWs (Section 5.5.8)	The EMBA (low threshold entrained hydrocarbons) may intersect the following NIWs: Lower Aire River Wetlands; Princetown Wetlands; Lake Connewarre State Wildlife Reserve; Lavinia Nature Reserve; and Western Port.. Low threshold entrained hydrocarbons are not predicted to have toxicological impacts on the waterbird species that these sites are important for. There are no NIWs that are intersected by high threshold entrained or dissolved phase hydrocarbons.
	Nationally threatened and migratory species	Some nationally threatened species and migratory species have the potential to be present in the MDO spill EMBA, particularly within their BIAs, but as evaluated in the previous tables in this section, the risks to individuals or populations of threatened and migratory species are mostly low.
	Other matters	
	State marine parks	The MDO EMBA intersects the following state marine parks: Twelve Apostles MNP; Point Addis MNP; Port Phillip Heads MNP Wilsons Promontory MP/MNP.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. .
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
As per the OPEP and OSMP.

Record Keeping	
Vessel assurance reports.	Crew training records.
Notice to Mariners.	Bunkering procedure.
Stakeholder consultation correspondence and register.	Bunkering PTWs, JSAs, inspection checklists.
SMPEP.	Oil spill response exercise records.
OPEP.	Inspection/audit reports.
ERP.	Incident reports.

7.17 RISK – Hydrocarbon Spill Response Activities

This section assesses the environmental and socio-economic risks associated with the MDO spill response strategies. Not all spill response options are appropriate for every spill type – responses vary based on key factors such as hydrocarbon type (light oil, heavy oil, refined oil), volume, location, sea state and trajectory.

Table 7-38 summarises the feasibility and effectiveness of the strategies available to respond to a Level 2 or 3 MDO spill, and whether they will be adopted. Only those that will be adopted are risk assessed in this section.

Table 7-38: MDO spill response options

Response option	Feasibility and effectiveness analysis	Adopt?
Source control	**Effectiveness** Implementing the vessel-specific SMPEP is the preferred manner in which to control an MDO release (e.g., transfer MDO from the ruptured tank to an intact tank, where possible). **Feasibility** This response strategy is effective based on the assumption that the vessel is not damaged to the point where electronic and hydraulic systems fail.	Yes
Monitor and Evaluate	**Effectiveness** MDO evaporates and disperses rapidly. MDO will be visible on the sea surface using satellite monitoring, vessel and aerial-based observations. **Feasibility** Monitoring is a fundamental part of any hydrocarbon spill response to gain situational awareness of the nature and scale of the spill and the direction of movement. Trained personnel at AMSA and within the oil and gas industry (via AMOSC) are readily available to undertake this monitoring.	Yes
Assisted Natural Dispersion	**Effectiveness** The use of motorised vessels to break up slicks using propeller wash creates an inherent safety risk because of the presence of an ignition source (MDO is highly volatile). **Feasibility** Mechanical dispersion could be undertaken in slightly weathered MDO once the volatiles have flashed off to disperse the MDO into the water column to create smaller droplets and enhance biodegradation (only if monitoring indicates the slick is moving to sensitive shorelines). The support vessels are able to undertake this task.	Yes
Chemical Dispersants	**Effectiveness** Although the use of dispersants is 'conditional' for Group II oil such as MDO, the potential spill volume and the natural tendency of spreading into very thin films is evidence that dispersant application will be an ineffective response. Dispersant droplets will penetrate through the thin oil layer and cause 'herding' of the oil, which creates areas of clear water and could be mistaken for successful dispersion. **Feasibility** Dispersant use will have a net negative effect on the environment. Dispersants push the MDO into the water column, creating longer lasting impacts in the water column than allowing the MDO to weather naturally from the sea surface.	No
Offshore Containment and Recovery	**Effectiveness** The high volatility of MDO creates inherent safety risks when attempting to contain and recover it mechanically. This response technique is dependent on adequate MDO thickness (generally >10 g/m^2), calm seas and significant areas of unbroken surface slicks.	No

Response option	Feasibility and effectiveness analysis	Adopt?
	Due to the low viscosity of MDO, the ability to contain and recover it is extremely limited. MDO evaporates faster than the collection rate of a thin surface film present. It spreads in less time than is required to deploy this equipment. **Feasibility** There is recoverable MDO (>10 g/m^2) at the sea surface for this spill scenario, however it is unlikely to be effective because the areas of high MDO concentration would weather in less time than is required to deploy response equipment.	
Protection and Deflection	**Effectiveness** The high volatility of MDO creates inherent safety risks when attempting to use protection and deflection booms. Oceanic environments such as Bass Strait and the Otway region often do not present suitable conditions for the use of booming material (i.e., swell and waves deem this strategy ineffective). **Feasibility** A shoreline protection and deflection response is not feasible for this activity because: Rocky shorelines present a high safety risk for response personnel in terms of access. MDO stranded on rocky substrate will weather rapidly due to the action of waves against the rocks. Shoreline loading is predicted only at the low and moderate threshold with maximum of 27.6 m^3 ashore, which will not result in toxicity impacts to fauna at the shoreline. Environmental impacts are likely to be higher when implementing this response technique compared to allowing for natural degradation.	No
Shoreline clean-up	**Effectiveness** MDO is highly volatile and will evaporate rapidly even after making shoreline contact. MDO also quickly infiltrates sand, where it is then remobilised by wave action (reworking) until it has naturally degraded. This quick infiltration through sediments makes it very difficult to recover without also recovering vast amounts of shoreline sediments. **Feasibility** Low shoreline loading is predicted in the OSTM. Therefore, unlikely need to deploy shoreline clean-up.	No
Oiled Wildlife Response (OWR)	**Effectiveness** Because MDO evaporates and disperses rapidly, most fauna are unlikely to be exposed to sub-lethal or lethal hydrocarbon concentrations that warrant wildlife capture and treatment, especially at the sea surface. **Feasibility** Low shoreline loading is predicted in the OSTM. Therefore, oiled wildlife on the shoreline is unlikely. Wildlife may become oiled in the offshore environment. Hazing may be considered to disperse animals away from a slick (such as seabirds, shorebird, seals and dolphins) or any shoreline areas where MDO has not infiltrated beach sediments. Only DELWP, DPIPWE or AMSA officers (or those authorised by these agencies) are permitted to handle and treat oiled wildlife. This may limit the effectiveness and feasibility of this response in terms of the number of responders and therefore the number of affected fauna that could be treated.	No

Table 7.40 indicates that only the following responses may be used to respond to a hydrocarbon spill:

- Source control;
- Monitor and evaluate; and
- Assisted natural dispersion.

The risks associated with these response techniques is discussed in this section.

7.17.1 Response Activity

7.17.1.1 Source Control

In the event of an MDO release, the key method of source control is outlined in the vessel-specific SMPEP (or equivalent based on class). The key response measures typically involve:

- Moving further out to sea (away from shoreline sensitivities) if the vessel is still able to navigate; and
- Transferring MDO from the affected tank/s to non-affected tanks.

7.17.1.2 Monitor and Evaluate

Ongoing monitoring and evaluation of a hydrocarbon spill is critical for maintaining situational awareness and to complement and support the other response activities. In some situations, monitoring may be the primary response strategy if natural dispersion and weathering processes are effective in reducing the volume of hydrocarbons reaching sensitive receptors (as is likely to be the case in this scenario).

Operational monitoring includes the following:

- Aerial observation (primarily by helicopter);
- Vessel-based observation;
- OSTM (computer-based and/or manual vector analysis); and
- Foot access along shorelines potentially at risk of contact (based on real-time OSTM).

7.17.1.3 Assisted Natural Dispersion

Assisted natural dispersion involves the use of motorised vessels to break up hydrocarbon slicks using propeller wash; essentially navigating a vessel in whatever pattern maximises travel through the slick to create smaller droplets and enhance biodegradation in the water column.

This activity is generally only necessary if monitoring indicates the slick is moving to sensitive shorelines.

7.17.2 Resource Availability

7.17.2.1 Monitor and Evaluate

Beach (through its membership with AMOSC), the DJPR (Emergency Management Branch, EMB) and DPIPWE (EPA Tasmania) maintain operational monitoring capability as outlined in Table 7-39.

Table 7-39: Resources available for monitoring and evaluation

Resource required	Beach resources	DJPR (EMB) resources	DPIPWE (EPA Tasmania resources)
Aviation	Beach will activate its contract with AMOSC to access helicopter and/or fixed aircraft to assist in spill monitoring.	Access to Emergency Management Victoria's (EMV's) State Aircraft Unit. Air support can be mobilised within 4 hours of request. Additionally, NatPlan resources can be activated.	A Memorandum of Understanding between the Tasmanian Fire Service (TFS) and EPA Tasmania details the agreement between parties and the response arrangements. Briefly, in addition to Control Agency roles, TFS will provide aircraft and aerial tactical response requirements including air attack supervisors for aerial dispersant application, air observers and aircraft staging areas in support of a marine incident.
Trained observers	Beach can request the assistance of AMOSC's Core Group personnel (>120 oil and gas industry personnel nation-wide) who are available 24/7 to respond to marine oil spills.	EMV's State Response Team (SRT) or AMSA Search and Rescue resources can be called upon, but is unlikely to be required given the AMOSC resources available. These resources are available within 4 hours of request. The SRT has 10 State Emergency Service (SES) volunteers and one DEDJTR staff member that are trained in oil on water observation.	
Vessel-based observations	Vessels of opportunity (VoO) based in ports nearest to the activity area, such as Port Campbell and Warrnambool would be engaged as required. VoO from ports slightly further afield, such as Geelong, Barry Beach (in Corner Inlet) Lakes Entrance and Stanley would also be considered.		
OSTM	Beach will activate its contract with AMOSC to access 24/7 emergency OSTM. OSTM results can generally be provided within 4 hours of request.	Available via AMSA upon request, who are likely to contract RPS.	

7.17.2.2 Assisted Natural Dispersion

The same VoO outlined under 'monitor and evaluate' would be used to implement assisted natural dispersion.

7.17.3 Hazards

The hazards associated with each of these response options are:

- Additional vessel activity (over a greater area than the activity area), resulting in additional routine emissions (air, noise) and routine discharges (sewage, putrescible waste, cooling water, etc); and
- Sound generated by helicopters.

7.17.4 Known and potential environmental impacts

The impacts and risks associated with these response options are:

- Routine and non-routine impacts and risks associated with vessel operations (as outlined throughout this chapter); and
- Noise disturbance to marine fauna and shoreline species by aerial flights.

7.17.5 EMBA

The EMBA for response activities would be dependent on the spill circumstances. It is possible that it may be larger than the socio-economic EMBA (see Section 5.1).

7.17.6 Evaluation of Environmental Impacts and Risks

7.17.6.1 Monitor and Evaluate

The impacts and risks associated with routine and non-routine vessel and helicopter activities are described and assessed throughout this chapter and are not repeated here. Foot access to beaches is not addressed in the EP and is therefore evaluated below.

Damage to shoreline habitat (such as sand dunes providing shorebird nesting habitat) may be caused if personnel veer from formed tracks. The noise, light and general disturbance created by shoreline monitoring activities (likely to involve foot traffic only, rather than vehicle traffic), may disturb the feeding, breeding, nesting or resting activities of resident and migratory fauna species that may be present. This is particularly the case for beach-nesting shorebirds, which may be present in some shorelines of the EMBA. As an example, the eggs of hooded plovers (that nest only on sandy beaches) have small eggs that are very well camouflaged, so they are easily trodden on by accident. If the incubating adult is scared off the nest by passers-by, the eggs may literally bake in the sun, or become too cold in the cool weather. Either way, it kills the chick developing in the egg, and the egg will not hatch. Similarly, when people disturb a chick, it quickly runs into the sand dunes and hides. While it is running, the chick uses up valuable energy, and while it is hiding it is unable to feed (they usually forage at the water's edge), so that a chick that is forced to run and hide throughout the day could easily starve. Any erosion caused by responder access to sandy beaches, may also bury nests. In isolated instances, this is unlikely to have impacts at the population level.

The presence of hydrocarbons in nearshore waters may necessitate temporary beach closures (likely to be in the order of days, depending on the degree of oiling). This means recreational activities (such as swimming, walking, fishing) in affected areas will be excluded until access is again granted by the local government authority. However, given shoreline loading above the minimum reporting threshold is not predicted in the OSTM, beach closure is unlikely to be required.

7.17.6.2 Assisted Natural Dispersion

The impacts and risks associated with routine and non-routine vessel activities are described and assessed throughout this chapter and are not repeated here.

7.17.7 Risk Assessment

Table 7-40 presents the risk assessment for hydrocarbon spill response activities

Table 7-40: Risk assessment for hydrocarbon spill response activities

Summary	
Summary of risks	Disturbance to marine and shoreline fauna.
Extent of risk	Localised – area immediately around vessel or aircraft

Duration of risk	Short-term (days to a week).
Level of certainty of risk	HIGH – the impacts associated with vessel discharges and noise disturbance to fauna from vessels and helicopters are well understood, and controls are documented in legislation.
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.

Risk Assessment (inherent)			
Receptor	Likelihood	Consequence	Risk rating
Fauna disturbance	Possible	Minor	Medium
Fauna injury	Possible	Minor	Medium
Fauna death	Unlikely	Minor	Low

EPO	EPS	Measurement criteria
Preparedness		
Source control Beach and its vessel contractors are operationally ready to respond to a spill.	The CSV has a current SMPEP in place.	Inspection/audit records verify a current SMPEP is in place.
Monitor and evaluate Beach maintains capability to implement hydrocarbon spill monitoring and response in a Level 2 or 3 spill event.	Access to operational response capabilities is maintained through the CSV paying the required shipping levy and Beach maintaining a current contract with AMOSC.	CSV pays required shipping levy. Contract with AMOSC is available and current.
	AMSA undertakes regular testing of response arrangements and equipment to ensure it is always ready to respond rapidly.	AMSA response capabilities are maintained in a manner that permits them to respond to spills rapidly (noted in annual reports).
	Beach undertakes a desktop drill prior to the activity commencing in order to test internal and external spill response communications.	Exercise drill report is available.
Response		
Source control The source of the release is stopped in the shortest time possible in accordance with established procedures.	MDO loss is managed through implementation of the vessel SMPEP (or equivalent according to class).	Incident logs verify that the SMPEP is implemented.
Monitor and evaluate Undertake visual observations to monitor spill behaviour and determine whether it is likely to reach sensitive receptors.	Visual observations from the CSV are initiated immediately.	Incident report verifies that visual observations commenced immediately following a spill.
	The NatPlan is activated so that AMSA can commence undertaking monitoring activities.	Incident communications log verifies that AMSA was contacted and asked to activate the NatPlan.
The trajectory of the spill is predicted based on the spill location in order to inform response strategies.	OSTM is undertaken in accordance with NatPlan requirements.	Incident records verify OSTM was undertaken.

Activity controls		
Monitor and evaluate Monitoring activities are undertaken in a manner that protects sensitive fauna and habitat.	Helicopters will maintain a buffer distances of 500 m around cetaceans in accordance with EPBC Regulations 2000 (Part 8).	Flight instructions document these constraints.
	Vessels will maintain buffer distances around whales and dolphins in accordance with The Australian National Guidelines for Whale and Dolphin Watching (DoEE, 2017b) for those individuals not visibly affected by hydrocarbons (closer approaches may be necessary to determine impacts).	Incident reports note when cetaceans were sighted and what actions were undertaken.
	Environmental briefings are conducted for shoreline monitoring crews to identify site-specific risks and suitable controls.	Briefing records are available.

Risk Assessment (residual)

Receptor	Likelihood	Consequence	Risk rating
Fauna disturbance	Unlikely	Minor	Low
Fauna injury	Unlikely	Minor	Low
Fauna death	Highly unlikely	Minor	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented below.

Table 7-38 provides a guide as to the suitability of response techniques for an MDO spill, including in the context of the OSTM undertaken for the activity. This should be taken into account into this demonstration of ALARP.

Good practice	
Avoid/Eliminate	Oil spill response activities will only be undertaken if the operational NEBA demonstrates that the net benefit of the response is greater than allowing the hydrocarbons to weather naturally.
Change the likelihood	The NatPlan will be used to guide the spill response activities. The use of trained AMSA, AMOSC and Beach personnel to monitor and respond to the reduces the likelihood and consequence of a poor response being implemented and creating more environmental damage than it prevents.
Change the consequence	This reduces the likelihood and consequence of additional environmental damage resulting from the response activities.
Reduce the risk	A pre-activity desktop exercise will be undertaken to ensure Beach and vessel contractors are aware of spill response risks and the measures in place to respond to a spill. This exercise reduces the risks associated with poor preparedness. Beach's contract with AMOSC reduces the risk of delays in instigating response measures (over and beyond those of AMSA).

Engineering risk assessment

The OSTM undertaken for the MDO spill scenario is an engineering risk assessment (consequence modelling) and supports the development of the EPS listed in this table.

The engineering control measures considered but not adopted because of the negative cost/benefit analysis are described below:

Use of autonomous underwater vehicles (AUV) – AUVs may be able to provide additional detail on hydrocarbons in the water column, but this does not assist with spill response options on the sea surface or at the shoreline. There are no practical means for removing hydrocarbons in the water column.

Night-time infrared monitoring – 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, however the benefit is minimal given trajectory monitoring (and infield monitoring during daylight hours) will provide good operational awareness. In addition to this, satellite imagery may be used at night to provide additional operational awareness.

Cost benefit analysis
Not applicable for an impact decision framework context of 'B'.

Demonstration of Acceptability		
Internal context	Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
	OEMS compliance	Chapter 8 describes the EP implementation strategy employed for this activity. It is demonstrated that all the standards in the OEMS have been met during the planning phase of this activity and can be met during the implementation phase of this activity.
Stakeholder engagement	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with activity. Relevant persons have not raised concerns about hydrocarbon spill response activities.	
Legislative context	The performance standards outlined in this EP align with the requirements of: *OPGGS Act* 2006 (Cth) and OPGGS(E) (Cth): Part 6.2 – directs the polluter to take actions in response to an incident and to clean up and monitor impacts. Regulation 13(5) (Risk assessment undertaken to demonstrate ALARP). EPBC Regulations 2000 (Cth): Part 8 (Interacting with cetaceans and whale watching). *Flora and Fauna Guarantee Act* 1988 (Vic). *Wildlife Act* 1975 (Vic). *Emergency Management Act* 2013 (Vic). *Pollution of Waters by Oil and Noxious Substances Act* 1987 (Tas). *Environmental Management and Pollution Control Act* 1994 (Tas). *Emergency Management Act* 2006 (Tas). *Emergency Management Act* 2004 (SA). *Environment Protection Act* 1993 (SA).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: Emergency preparedness and response – spill preparedness and emergency response measures are in place.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding oil spill response activities, other than having a spill contingency plan in place. An OPEP is in place for the activity.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: Sections 76-79 (Spill response planning): A spill response plan should be prepared.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level.

	Hydrocarbon spill-specific guidelines	
	NatPlan (AMSA, 2020).	• AMSA will implement this plan in the event their resources are deployed. The EPS listed in this table complement the NatPlan.
	AMOSPlan (2017)	• AMOSC will implement this plan in the event their resources are deployed. The EPS listed in this table complement AMOSPlan.
	Maritime Emergencies Plan NSR (EMV, 2016).	• DJPR (EMB) will implement this plan in the event their resources are deployed. The EPS listed in this table complement the Marine Emergencies Plan.
	Tasmanian Marine Oil and Chemical Spill Contingency Plan (TasPlan) (EPA Tasmania, 2019)	• DPIPWE will implement this plan in the event their resources are deployed. The EPS listed in this table complement the TasPlan.
	Contingency planning for oil spills on water – Good practice guidelines for incident management and emergency response personnel (IPIECA/IOGP, 2015).	• The EPS listed in this table are prepared cognisant of these guidelines, which discuss oil spill scenarios, various response techniques and the requirements for contingency plan preparation.
	Oil spill training - Good practice guidelines on the development of training programmes for incident management and emergency response personnel (IPIECA/IOGP, 2014).	• The EPS listed in this table are prepared cognisant of these guidelines, in so far as training of Beach and contractor personnel in oil spill preparedness and response takes place and is overseen by an emergency response specialist.
	Aerial Observations of Marine Oil Spills (ITOPF, 2011B). Aerial Observations of Oil Spills at Sea (IPIECA/OGP, 2015).	• The EPS listed in this table related to monitoring were prepared cognisant of these guidelines, which describe monitoring techniques and outline the importance of monitoring in guiding on-water and shoreline response activities.
Environmental context	MNES	
	AMPs	Oil and chemical spills are a threat identified in the South-east Commonwealth Marine Reserve Network Management Plan 2013-2023. Spill response will not be undertaken in AMPs given that actionable surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on AMPs.
	Wetlands of international importance	Spill response will not be undertaken in Ramsar wetlands given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on Ramsar wetlands.
	TECs	Spill response will not be undertaken in areas where TECs exist. Vessel or aircraft-based monitoring activities will have no impacts on TECs.
	NIWs	Spill response will not be undertaken in NIWs given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on NIWs.
	Nationally threatened and migratory species	Some threatened and migratory species have the potential to be present in spill response areas but given that the key response strategy is centred on monitoring and surveillance because of the volatile nature of the hydrocarbons, vessel or aircraft-based monitoring activities will have no impacts on threatened and migratory species.

	Other matters	
	State marine parks	Many of the Victorian marine and coastal reserve management plans list the protection of marine and terrestrial ecological communities and indigenous flora and fauna, particularly threatened species, as a management aim. Spill response may be undertaken in coastal marine parks given that shoreline loading is predicted to contact some parks. Land, vessel or aircraft-based monitoring activities will have no significant impacts on these marine parks or the management objectives of the parks' management plans.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The risks posed by response operations do not impact this action. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. Land, aerial or vessel-based observations will not conflict with the management objectives of these plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
As per NatPlan requirements.

Record Keeping	
Contracts and agreements with third parties.	Operational NEBA.
Equipment and service provider register.	Briefing records.
Exercise drill reports.	Photos.
Inspection/audit reports.	OSMP implementation records and reports.
Incident and daily operations reports.	IAP.

8 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 2-1). 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.

8.1 Operations Excellence Management System (OEMS)

The activity will be undertaken in accordance with the Beach OEMS. 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 2-1) and management of potential HSE impacts and risks (Figure 8-1, Table 8-1). 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 8-1: Beach's OEMS system

8.2 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.

There are three standards (see Table 8-1) and 11 outcomes to be delivered under this element. To this effect, Beach's Environment Policy provides a clear commitment to conduct its operations in an environmentally responsible and sustainable manner.

Demonstratable compliance with this EP is a key commitment for Beach. This will be managed through the use of a commitments register to track all EP commitments through to completion.

The Beach Energy CEO has the ultimate responsibility for ensuring that Beach The Beach Project Manager and Principal Environmental Advisor (offshore), have the responsibility and delegated authority to ensure that adequate and appropriate resources are allocated to comply with the OEMS and this EP.

The organisation structure for the activity is illustrated in Figure 8-2 and the roles responsibilities for the implementation, management and review of this EP are detailed in Table 8-2.

Table 8-1: Beach OEM Elements and Standards

Element		Standard
1	Partners, Leadership and Authority	Leadership Standard
		Technical Authority Standard
		Joint Venture Management Standard
2	Financial Management and Business Planning	Integrated Planning Standard
		Phase Gate Standard
		Hydrocarbon Resource Estimation and Reporting Standard
		Financial Management Standard
3	Information Management and Legal Requirements	Regulatory Compliance Standard
		Document Management Standard
		Information Management Standard
4	People, Capability and Health	Training and Competency Standard
		Health Management Standard
5	Contracts and Procurement	Contracts and Procurement Standard
		Transport and Logistics Standard
6	Asset Management	Asset Management Standard
		Maintenance Management Standard
		Well Integrity Management Standard
		Well Construction Management Standard
		Project Management Standard
7	Operational Control	Operational Integrity Standard
		Process Safety Standard
		Management of Change Standard
8	Risk Management and Hazard Control	Risk Management Standard
		Safe Systems of Work
		Emergency and Security Management Standard
9	Incident Management	Incident Management Standard
10	Environment and Community	Environment Management Standard
		Community Engagement Standard
11	Assurance and Reporting	Sustainability Standard
		Assurance Standard

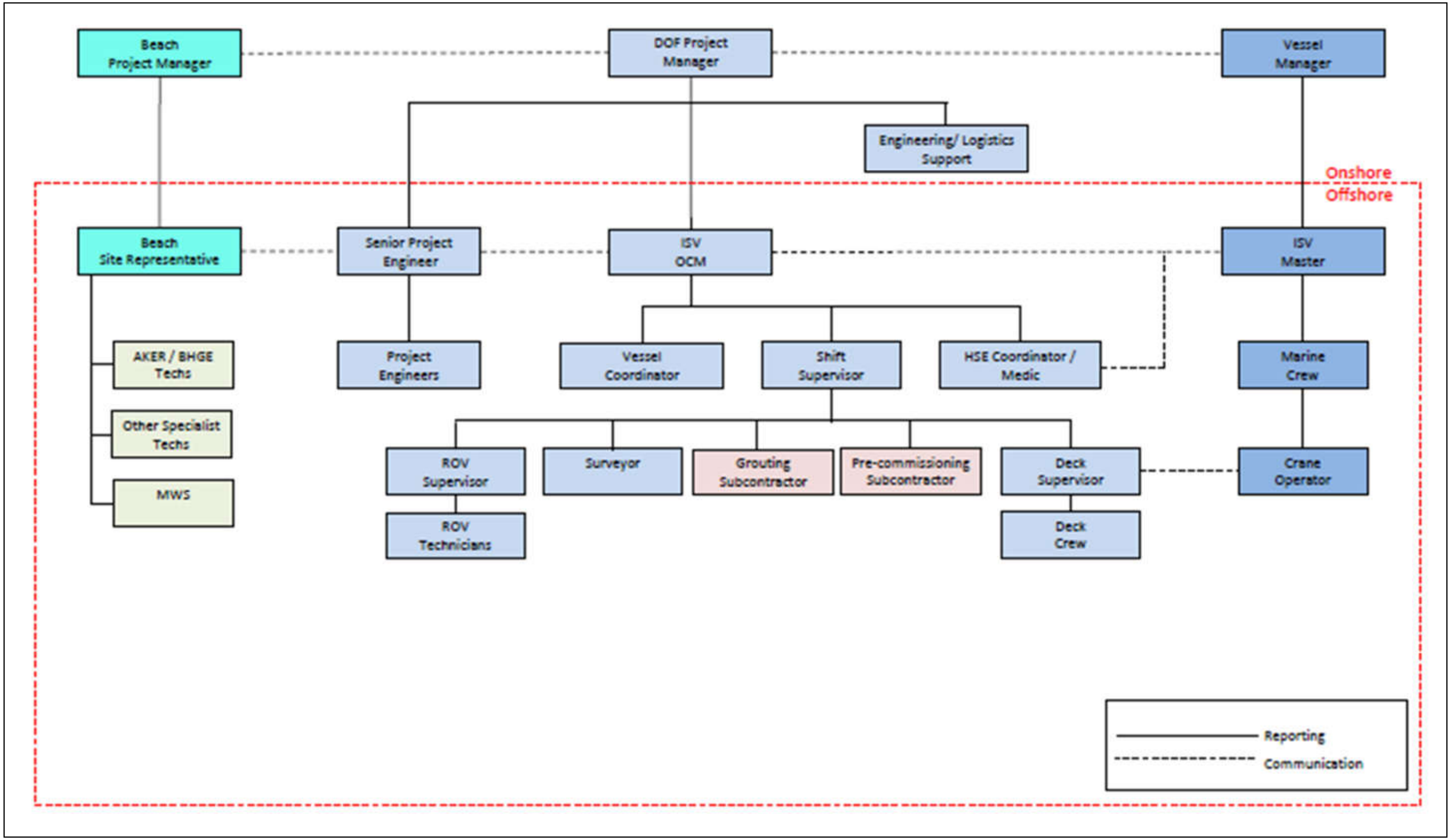


Figure 8-2: Thylacine subsea installation organisation chart

Table 8-2: Roles and responsibilities

Role	Responsibilities
Onshore	
Chief Executive Officer	Ensures: Beach has the appropriate organisation in place to be compliant with regulatory and other requirements and this EP. Policies and systems are in place to guide the company's environmental performance. Adequate resources are in place for the safe operation of all activities. OEMS continues to meet the evolving needs of the organisation.
Beach Otway Project Manager	Ensures: Compliance with regulatory and other requirements and this EP. Records associated with the activity are maintained as per Section 8.4.2. Personnel who have specific responsibilities pertaining to the implementation of this EP or 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 (MoC) process detailed in Section 8.8.1. Incidents are managed and reported as per Section 8.10. The EP environmental performance report is submitted to NOPSEMA within three months of activity completion. Changes to equipment, systems and documentation where there may be a new or change to an environmental impact or risk or a change that may impact the EP are assessed in accordance with the MoC process detailed in Section 8.8.1. Oil spill response arrangements for the activity are tested as per Section 9.4. Audits and inspections are undertaken in accordance with Section 8.12.1.4.
Beach Principal Environment Advisor	Ensures: 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 8.10. The monthly and end-of-activity EP environmental performance report are prepared and submitted. 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 8.8.1. That audits and inspections are undertaken as detailed in Section 8.12.1.4 and any actions from non-conformances or improvement suggestions tracked. Reviews and revisions to the EP are made as per the requirements in Section 8.12.
Beach Community Relations Manager	Ensures: Stakeholder consultation for the activity is undertaken in a timely and thorough manner. Objections or claims raised by stakeholders are recorded and reported to the Project Manager and Principal Environmental Advisor (offshore). A stakeholder consultation log is maintained. Stakeholder issues are addressed.
Offshore	
Beach Offshore Representative	Ensures: The activity is carried out in accordance with regulatory requirements and this EP. Vessel personnel participate in the activity induction. Vessel personnel are competent to fulfil their designated role.

Role	Responsibilities
	HSE issues are communicated via mechanisms such as the daily report, daily pre-start meetings and weekly HSE meeting. New or increased environmental impacts or risks are managed via the MoC process detailed in Section 8.8.1. Environmental incidents are reported and investigated as per Section 8.10. Emissions and discharges identified in Section 8.12.1.1 are recorded and reported in the end-of-activity EP performance report. The Project Manager is informed of any changes to equipment, systems and documentation where there may be a new or change to an environmental impact or risk or a change that may impact the EP as per Section 8.12. Weekly HSE vessel inspections as detailed in Section 8.12.1.4 are undertaken to ensure ongoing compliance with the EP.
Vessel Master	Ensures: Vessel operations are carried out in accordance with regulatory requirements and this EP. Vessel personnel are competent to fulfil their designated role. Personnel new to the vessel receive a vessel-specific induction. Environmental incidents are reported to the Beach Offshore Representative within required timeframes as per Section 8.10. The Beach Offshore Representative is informed of any changes to equipment, systems and documentation where there may be a new or change to an environmental impact or risk or a change that may impact the EP as per Section 8.12. General and hazardous wastes are backloaded to port for disposal to a licenced waste facility. 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 8.10. Oil spill response arrangements are in place and tested as per the vessel's SMPEP or equivalent.
MMOs	Ensures: That vessel crew are briefed about their role in supporting the MMOs to fulfil their duties. That the EPBC Policy Statement 2.1 procedures and additional controls detailed in Section 7.3.5 are implemented throughout the activity. A daily log of cetacean sightings is maintained. That continuous liaison is maintained with the Party Chief and Beach Offshore Representative regarding MMO implementation issues. An end-of-survey MMO report is prepared for submission to DCCEEW.
Vessel personnel	All vessel crew are responsible for: Completing the Beach HSE induction. Reporting fauna sightings and interactions to the Beach Offshore Representative or MMOs. Reporting hazards and/or incidents via company reporting processes. Adhering to vessel's HSEMS and this EP in letter and in spirit. Undertaking tasks safely and without harm to themselves, others, equipment or the environment and in accordance with their training, operating procedures and work instructions. Stopping any task that they believe to be unsafe or will impact on the environment

This element recognises that a systematic risk-based approach to HSE management is in place as an integral part of leadership and planning, and that HSE goals and targets must be established and measured. A philosophy of continuous improvement is applied to all Beach operations.

Targets for environmental performance of the activity are detailed throughout Chapter 7 of this EP. The EPO and EPS have been established to ensure that the impacts of planned activities and the risks of unplanned events are managed to ALARP and to an acceptable level.

Additionally, the EPO and EPS emerging from this Implementation Strategy are summarised in Section 8.13.

8.3 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 8-1) 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.

8.4 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 8-1) and seven outcomes to be delivered under this element. The standards relevant to the implementation of this EP are described below.

8.4.1 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.

8.4.2 Standard 3.2 – Document Management Standard

Standard 3.2 specifies the minimum requirements to ensure that all Beach documents and records are managed in alignment with legal, regulatory and stakeholder requirements. It requires documents to be classified, developed, authorised, published, stored, accessed, reviewed and disposed consistently and in a manner that complies with company and statutory obligations. The document management system will clearly support the safe and efficient operations of the Company.

In accordance with Regulations 27 and 28 of the OPGGS(E), documents and records relevant to the implementation of this EP are stored and maintained in the Beach document control system ('BoardWalk') for a minimum of five years. These records will be made available to regulators in electronic or printed form upon request.

8.4.3 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.

8.5 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 8-1) 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.

8.5.1 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 8.4.2. The induction will at a minimum cover:

- description of the environmental sensitivities and conservation values of the activity 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.

The Beach Offshore Representative is responsible for delivering the induction, or facilitating it if presented by another member of the project team.

The vessel contractor will conduct their own company and vessel-specific inductions independently of the activity-specific HSE induction.

This element also includes the management of HSE risks to personnel associated within the working environment and encourages a healthy lifestyle for its employees and provides formal programs to promote health and fitness. These are not related to the implementation of the EP and are not addressed here.

The Project Manager has responsibility for ensuring that systems are in place to facilitate the communication of HSE issues to vessel crew. This is typically via the daily operations meeting and weekly HSE meetings.

8.5.2 Toolbox Talks and HSE Meetings

Environmental matters will be included in daily toolbox talks as required by the specific task being risk assessed (e.g., waste management).

Environmental issues will also be addressed in daily operations meetings and weekly HSE meetings, where each shift will participate with the Beach Offshore Representative and Vessel Master in discussing HSE matters that have arisen in the previous week, and issues to consider for the following week.

Records associated with project-specific training, environmental training, inductions and attendance at toolbox meetings will be recorded and maintained on board the vessel.

8.5.3 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:

- 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.

Table 8-3 outlines the key meetings that will take place onshore and offshore during the activity.

Table 8-3: Project communications

Meeting	Frequency	Attendees
Onshore		
Beach project team	Daily	All team members
Offshore		
Operations (including whale management strategy)	Daily	Beach onshore project team, department heads, Beach Offshore Representative
Pre-start safety meeting	Daily – prior to each shift	All personnel
Toolbox	Before each task	All personnel involved in task
HSE	Weekly	All personnel
MMOs	Daily	MMOs, Beach Offshore Representative, vessel operator

8.6 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 8-1) 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 8.6 details how the contractors will be assessed to ensure they have the capabilities and competencies to implement the control measures identified in Chapter 7.

8.7 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 8-1) 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 Chapter 7. During the contractor selection process and through ongoing inspections during the activity, Beach will ensure that the contractor maintains all plant and equipment in good working order.

8.8 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 8-1) and ten outcomes to be delivered under this element. The standard of relevance to this EP Management of Change is discussed below.

8.8.1 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 8.9 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.

8.9 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 8-1) and seven outcomes to be delivered under this element. The standards of relevance to this EP are discussed below.

8.9.1 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 8.12.1.3 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 trigged though a change in risk or controls, the revision process shall be managed in accordance with the MoC process outlined in Section 8.8.1.

8.9.2 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.

8.9.2.1 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 8-3. 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 8-4

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.

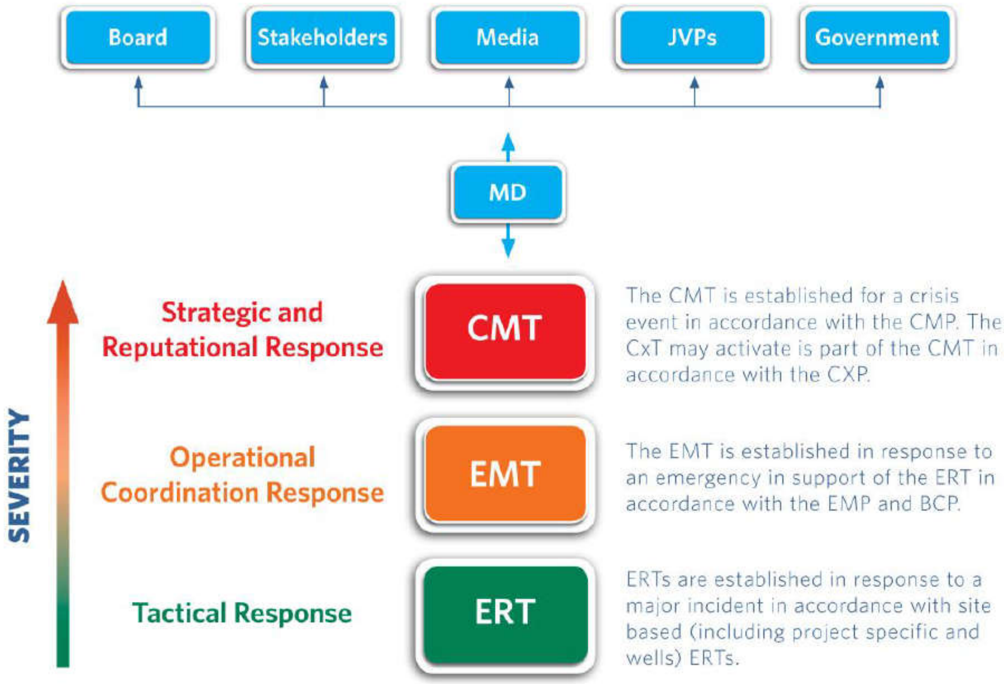


Figure 8-3: Beach Crisis and Emergency Management Framework

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 9.4).

Table 8-4: Responsibilities of the Beach Crisis and Emergency Management Teams

Team	Base	Responsibilities
CMT	Adelaide head office	Strategic management of Beach's response and recovery efforts in accordance with the Crisis Management Plan. Provide overall direction, strategic decision-making as well as providing corporate protection and support to activated response teams. Activate the Crisis Management Team (CMT) if required.
EMT	Adelaide, Melbourne	Provide operational management support to the Emergency Response team to contain and control the incident. implement the Business Continuity Plan. Liaise with external stakeholders in accordance with the site-specific Emergency Response Plan. Regulatory reporting.
ERT	Site/Vessel	Respond to the emergency in accordance with the site-specific ERP.

Adverse Weather Protocols

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

During adverse weather, the Vessel Master is responsible for the following:

- Ensuring the safety of all personnel onboard;
- Monitor all available weather forecasts and predictions;
- Initiating the vessel safety management system, vessel HSE procedures and/or vessel ERP;
- Keeping the Beach Offshore Representative fully informed of the prevailing situation and intended action to be taken;
- Assessing and maintaining security, watertight integrity and stability of vessel; and
- Proceeding to identified shelter location(s) as appropriate.

Other appropriate responsibilities shall be taken into consideration as dictated by the situation.

In addition to in-vessel VHF Marine Radio Weather Services, the vessel contractor will obtain daily weather forecasting from the Bureau of Meteorology (and/or other services) to monitor weather within the activity area in the lead up to and for the duration of the activity.

8.10 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 8-1) and five outcomes to be delivered under this element, with the standard discussed below.

8.10.1 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.

8.10.1.1 Recordable Incident Management

Regulation 4 of the OPGGS(E) regulations defines a 'recordable' incident as:

> *A breach of an EPO or EPS in the EP that applies to the activity that is not a reportable incident.*

Routine monthly recordable incident reports, including 'nil' incident reports, are prepared by the Beach Principal Environment Advisor (offshore) and submitted to NOPSEMA by the 15th of each month. These are reported using the NOPSEMA template Monthly Environmental Incident Reports (N-03000-FM0928). Table 8-5 summarises the recordable incident reporting requirements.

Table 8-5: Recordable incident reporting details

Timing	Reporting requirements	Contact
By the 15th of each month	• All recordable incidents that occurred during the previous calendar month. • The date of the incident. • All material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out. • The EPO and/or EPS breached. • Actions taken to avoid or mitigate any adverse environmental impacts of the incident. • Corrective actions taken, or proposed to be taken, to stop, control or remedy the incident. • Actions taken, or proposed to be taken, to prevent a similar incident occurring in the future. • Actions taken, or proposed, to prevent a similar incident occurring in the future.	NOPSEMA – submissions@nopsema.gov.au

8.10.1.2 Reportable Incident Management

Regulation 4 of the OPGGS(E) defines a 'reportable' incident as:

> *An incident that has caused, or has the potential to cause, moderate to significant environmental damage.*

In the context of the Beach Environmental Risk Matrix, Beach interprets 'moderate to significant' environmental damage to be those hazards identified through the EIA and ERA process (see Chapter 7) as having an inherent or residual impact consequence of 'serious (3)' or greater. There is only one risk with this rating (as outlined throughout Chapter 7):

- RISK – Introduction of IMS (Section 7.14).

Table 8-6 presents the reportable incident reporting requirements.

Table 8-6: Reportable incident reporting requirements

Timing	Requirements	Contact
Verbal notification		
Within 2 hours of becoming aware of incident	The verbal incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; and • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	• NOPSEMA – 1300 674 472
	For a Level 1, 2 or 3 hydrocarbon spill, as above.	As above, plus: • AMSA – 1800 641 792 (24 hrs) • DJPR (Vic) – 0409 858 715 • DPIPWE (Tas) – 03 6165 4599

Timing	Requirements	Contact
	For a Level 2 or 3 hydrocarbon spill only.	• Watersure – 03 5671 9041
	Oiled wildlife	• DELWP (Vic) – 1300 134 444 (24 hrs) • DPIPWE (Tas) - 03 6165 4599
	Suspected or confirmed IMS introduction	• DELWP – 136 186 (24 hrs) • DCCEEW - 1800 803 772 (general enquiries)
	Injury or death of EPBC Act-listed or FFG Act-listed fauna (e.g., vessel collision)	• DELWP – 1300 134 444 (24 hrs) • DCCEEW – 1800 803 772 • Whale and dolphin emergency hotline – 1300 136 017 • AGL marine response unit – 1300 245 678
Written notification		
Not later than 3 days after the first occurrence of the incident	A written incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent similar recordable incidents occurring in the future.	• NOPSEMA – submissions@nopsema.gov.au
Within 72 hours of the incident	As above, with regard to details of a vessel strike incident with a cetacean	• Upload information to DCCEEW online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike) • DELWP (Whale and Dolphin Emergency Hotline) – 1300 136 017 • Seals, Penguins or Marine Turtles – 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678.
Within 7 days of the incident	As above, with regard to impacts to MNES, specifically injury to or death of EPBC Act-listed species	• EPBC.Permits@environment.gov.au • DCCEEW 1800 803 772
Within 7 days of providing written report to NOPSEMA	As above.	• NOPTA – reporting@nopta.gov.au

8.10.1.3 Incident Investigation

Any non-compliance with the EPS outlined in this EP will be investigated and follow-up action will be assigned as appropriate.

The findings and recommendations of inspections, audits and investigations will be documented and distributed to relevant vessel and project personnel for review. Tracking the close-out actions arising from investigations is managed via the Beach CMO Incident Management System.

Investigation outcomes will be communicated to the project team via daily operations meetings and to the vessel crew during daily toolbox meetings and at weekly HSE meetings. Notification and reporting requirements for environmental incidents to external agencies are provided in Table 8-7.

Table 8-7: Regulatory incident reporting

Requirement	Timing	Contact	Responsible Person
Recordable incident As defined within the OPGGS(E)R a recordable environmental incident is a breach of an EPO or EPS in the EP that applies to the activity that is not a recordable incident.			
As a minimum, the written monthly recordable report must include a description of: all recordable incidents which occurred during the calendar month; all material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out; corrective actions taken to avoid or mitigate any adverse environmental impacts of the incident; and corrective actions that have been taken, or may be taken, to prevent a repeat of similar incidents occurring. Regulation 26B of the OPGGS(E)R requires a recordable incident report to be submitted if there is a recordable incident, thus nil reports are not required.	Before the 15th day of the following calendar month	NOPSEMA – submissions@nopsema.gov.au	Offshore Project Manager
Reportable incident As defined within the OPGGS(E)R, a reportable incident is an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage. In the context of the Beach Environmental Risk Matrix moderate to significant environmental damage is defined as any incident of actual or potential consequence category Serious (3) or greater. These risks include: pipeline or well loss of containment. vessel collision resulting in a loss of containment or otherwise. introduction of marine pests to the activity area			
Verbal notification The notification must contain: all material facts and circumstances concerning the incident; any action taken to avoid or mitigate the adverse environmental impact of the incident; and the corrective action that has been taken or is proposed to be taken to stop control or remedy the reportable incident.	Within two hours of becoming aware of incident	NOPSEMA – 1300 674 472 NOPSEMA – submissions@nopsema.gov.au DJPR – marine.pollution@ecodev.vic.gov.au (0409 858 715) NOPTA – reporting@nopta.gov.au	Offshore Project Manager

Requirement	Timing	Contact	Responsible Person
Written notification Verbal notification of a reportable incident to the regulator must be followed by a written report. As a minimum, the written incident report will include: the incident and all material facts and circumstances concerning the incident; actions taken to avoid or mitigate any adverse environmental impacts; the corrective actions that have been taken, or may be taken, to prevent a recurrence of the incident; and the action that has been taken or is proposed to be taken to prevent a similar incident occurring in the future.	Within 3 days of notification of incident	NOPSEMA – submissions@nopsema.gov.au	Offshore Project Manager
Written incident reports to be submitted to NOPTA and DJPR (for incidents in Commonwealth waters).	Within 7 days of written report submission to NOPSEMA	DJPR – marine.pollution@ecodev.vic.gov.au NOPTA – reporting@nopta.gov.au	Offshore Project Manager
Vessel spill to marine environment All discharges /spills or probable discharges/spills to the marine environment of oil or oily mixtures, or noxious liquid substances in the marine environment from vessels. Reporting info: http://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf.	Verbal notification ASAP	Immediate notification by the Vessel Master to AMSA. Follow-up with Marine Pollution Report (POLREP). Ph: 1800 641 792 Email: rccaus@amsa.gov.au AMSA POLREP: https://amsa-forms.nogginoca.com/public/	Vessel Master
AMP – in the event an AMP may be exposed to hydrocarbons	Verbal notification ASAP	Marine Park Compliance Duty Officer – 0419 293 465 Notification must be provided to the Director of National Parks and include: titleholder details; time and location of the incident (including name of marine park likely to be affected); proposed response 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	DCCEEW – online National Ship Strike Database https://data.marinemammals.gov.au/report/shipstrike	Vessel Master
	ASAP for cetacean injury assistance	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

Requirement	Timing	Contact	Responsible Person
Injury to or death of EPBC Act-listed species	Within seven days	DCCEEW – 1800 803 772 EPBC.Permits@environment.gov.au	Environment Advisor
Suspected or confirmed Invasive Marine Species introduction	Verbal notification ASAP	Department of Environment, Land, Water and Planning – 136 186	Environment Advisor
Identification of any historic shipwrecks, aircraft or relics	Written notification within 1 week	written notification via the notification of discovery of an historic shipwreck or relic online submission form.	Offshore Project Manager

8.11 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 8-1) and three outcomes to be delivered under this element, with the standards discussed below.

8.11.1 Standard 10.1 – Environment Management Standard

Standard 10.1 ensures that Beach implements appropriate plans and procedures to conduct its operations in an environmentally responsible and sustainable manner. The standard defines the requirement to assess environmental impacts and risks that may result from the company's operations and for site-specific management plans to protect the environment from harm. The standard covers land disturbance, reinstatement and rehabilitation activities, and defines obligations for management of biodiversity, water systems, air quality, noise and vibration, amenities and waste.

This EP provides the key means of satisfying this OEMS standard. Three processes identified as controls in Chapter 7 are described below.

8.11.1.1 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 DCCEEW within three months of the activity completion.

The controls outlined in Section 7.3.5 are summarised in a flowchart presented in Figure 8-4. This flowchart will be provided to the MMO in order to implement these measures throughout the activity.

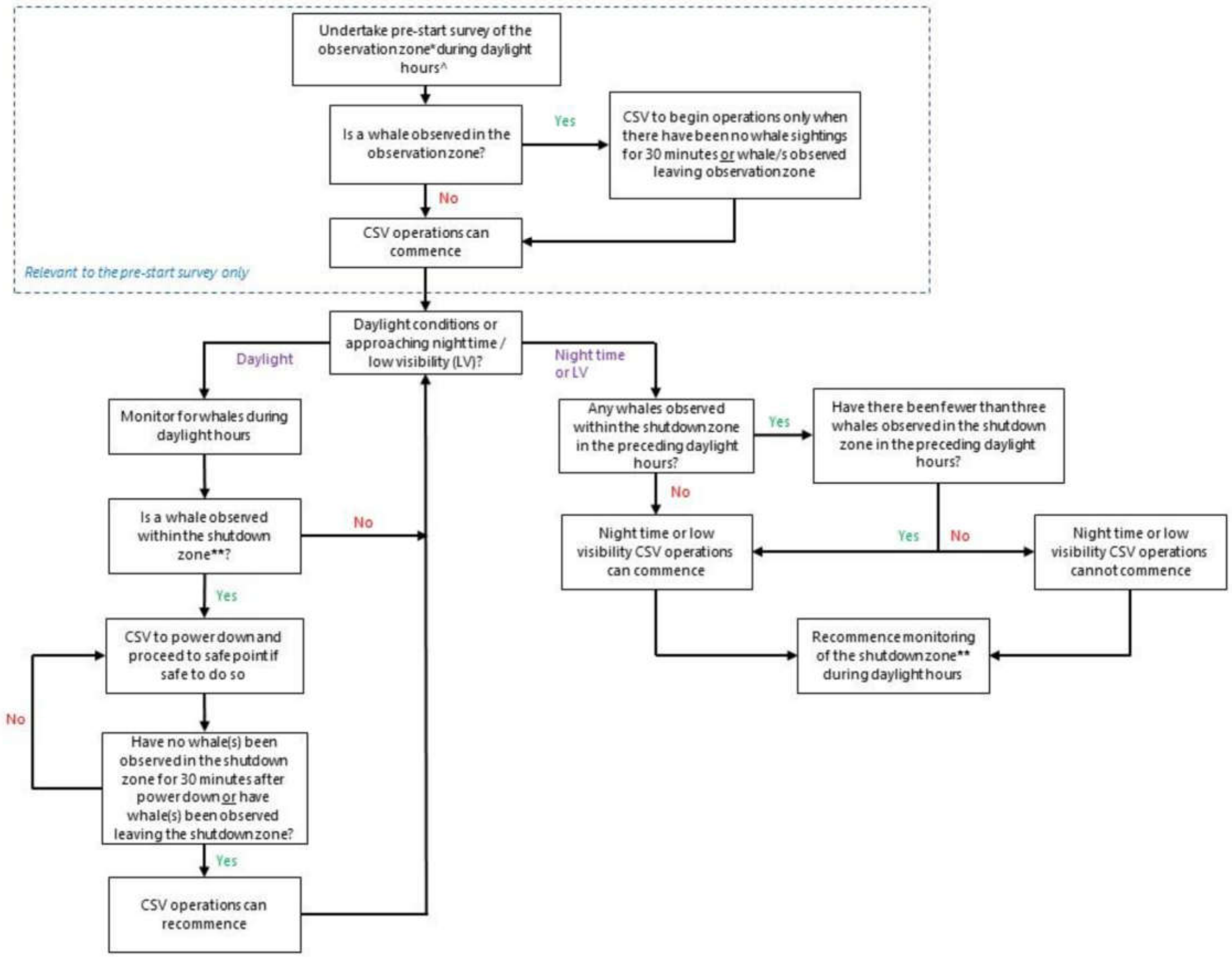


Figure 8-4: Whale management procedure

8.11.1.2 Chemical Management Plan

The Hazardous Materials and Secondary Containment Directive addresses the management of hazardous substances and dangerous goods (termed "hazardous materials") on Beach controlled sites/facilities.

The Beach Chemical Management Plan (S400AD719917) is used to assess chemicals that could be discharged to the marine environment to ensure that the impacts and risks associated with offshore discharge are reduced to ALARP. It considers aquatic toxicity, bioaccumulation and persistence data, along with the discharge concentration, duration, frequency, rate, and volume to assess chemicals that may or will be discharged to the marine environment. The assessment and outcome is recorded on the Offshore Chemical Register.

Figure 8-5 provides a summary of the offshore chemical environmental risk assessment process.

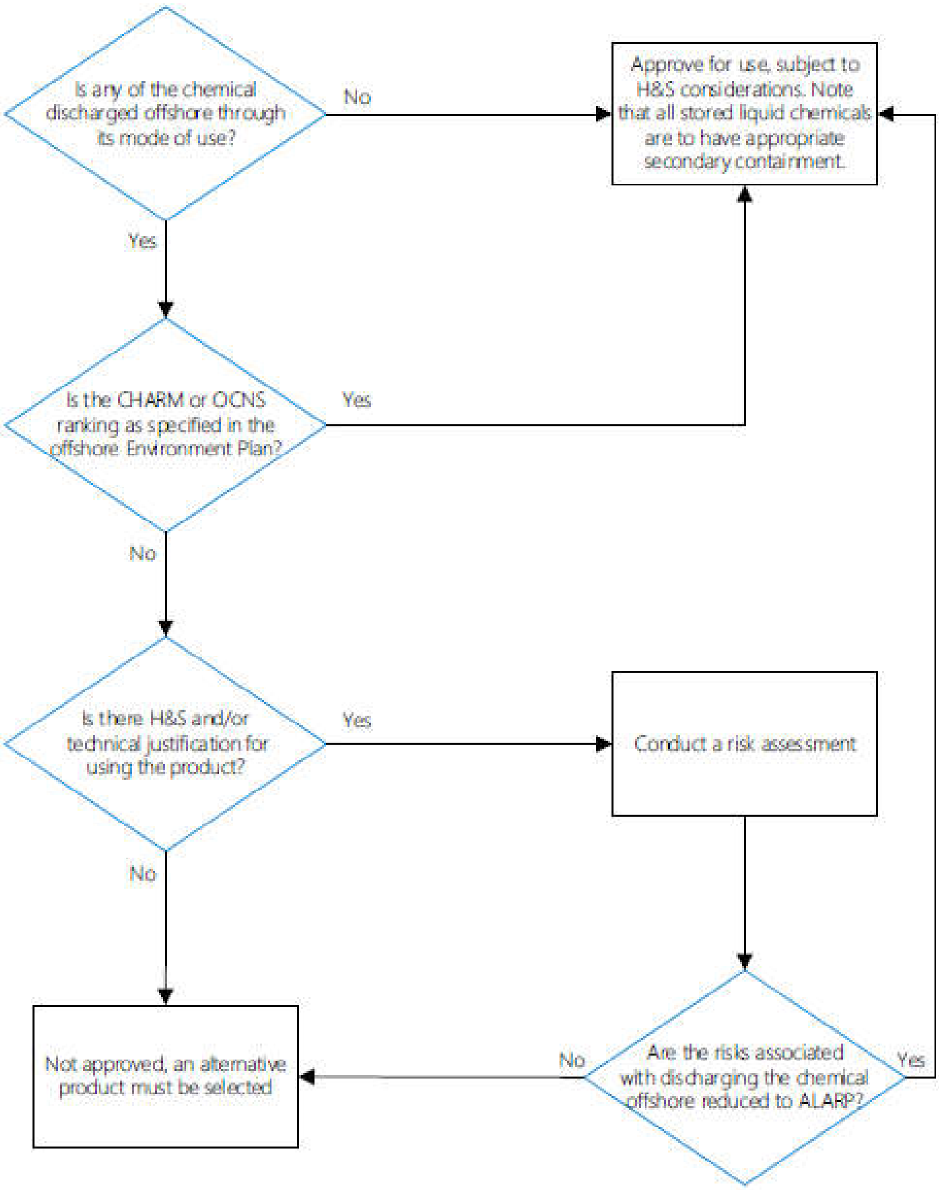


Figure 8-5: Beach offshore chemical environmental risk assessment process summary

8.11.1.3 Beach Energy Domestic IMS Biofouling Risk Assessment Process

Scope

All vessels mobilised from domestic waters to undertake offshore petroleum activities within the activity 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 activity 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 activity area;
- Identify the potential IMS risk profile of vessels prior to deployment within the activity area;
- Identify potential deficiencies of IMS controls prior to entering the activity 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 activity area).

Screening Assessment

Prior to the initial mobilisation of the vessels to the activity 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 activity 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 activity 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.

8.11.2 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 Chapter 4 of this EP.

8.12 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 8-1) and four outcomes to be delivered under this element, with the standards relevant to the activity discussed below.

8.12.1 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.

The assurance methods that will be used to ensure compliance with the EPS in this EP are described in this section.

8.12.1.1 Emissions and Discharge Records

Beach maintains a quantitative record of emissions and discharges as required under Regulation 14(7) of the OPGGS(E). This includes emissions and discharges to air and water (from both planned and unplanned activities). Results are reported in the end-of-activity EP performance report submitted to NOPSEMA.

A summary of the environmental monitoring to be undertaken for the activity from the vessel is presented in Table 8-8.

Table 8-8: Summary of environmental monitoring

Aspect	Monitoring parameter	Frequency	Record
Impacts			
Underwater sound	MMO observations	Continuous during activity	MMO daily reports End-of-activity report
Atmospheric emissions	Fuel consumption	Tallied at end of activity from daily reports and/or bunker receipts	Emissions register
Bilge water	Volume of bilge water discharged during the activity	Each discharge (infrequent)	Oil record book
Risks			
Waste disposal	Weight/volume of wastes sent ashore (including oil sludge, solid/hazardous wastes)	Tallied at end of activity	Waste manifest
Displacement of or interaction with third-party vessels	Ongoing patrol for, and communications with, third-party vessels by the support vessels. Radar surveillance from source vessel.	Continuous during activity	Bridge communications book
Introduction of IMS to activity area	Volume and location of ballast water discharges noted	Each discharge	Ballast water log
Vessel strike with cetaceans	MMO continuous megafauna observations	Continuous during activity	Incident report
MDO spill	Operational monitoring in line with the OPEP and scientific monitoring in line with the OSMP (depending on spill volume)	As required	Incident reports

8.12.1.2 Routine Reporting and Notifications

Regulation 11A of the OPGGS(E) specify that consultation with relevant authorities, persons and organisations must take place. This consultation includes an implicit obligation to report on the progress of the activity. Table 8-9 outlines the routine reporting obligations that Beach will undertake with external organisations.

Table 8-9: External routine reporting obligations

Requirement	Timing	Contact details	OPGGS(E) regulation
Pre-activity			
Notify AMSA's Joint Rescue Coordination Centre (JRCC) in order to issue daily AusCoast warnings.	Within 24 - 48 hours of activity starting.	rccaus@amsa.gov.au 1800 641 792 +61 2 6230 6811	11A
Notify NOPSEMA with the activity commencement date.	At least 10 days prior to activity starting.	submissions@nopsema.gov.au	29
Notify all other stakeholders in the stakeholder register with the activity commencement date.	Two weeks prior to activity starting.	Via email addresses managed by the Community Manager	11A
Notify the AHO of the activity commencement date and duration to enable Notices to Mariners to be issued.	Three weeks prior to activity starting.	datacentre@hydro.gov.au, 02 4223 6500	11A
Activity completion			
Notify AMSA in order to cease daily AusCoast warnings.	Within 24 hours of activity completion.	rccaus@amsa.gov.au	11A
Notify all stakeholders in the stakeholder register.	Within 2 days of activity completion.	Via email addresses managed by the Community Manager	11A
Notify the AHO in order to cease the issuing of Notices to Mariners.	Within 2 days of activity completion.	datacentre@hydro.gov.au, 02 4223 6590	11A
Notify NOPSEMA of the activity end date.	Within 10 days of activity completion.	submissions@nopsema.gov.au	29
Notify NOPSEMA of the end of the operation of the EP.	After acceptance of the end-of-activity EP performance report.	submissions@nopsema.gov.au	25A
Performance reporting			
Submit an end-of-activity EP Performance Report.	Within 3 months of activity completion.	submissions@nopsema.gov.au	26C
Provide marine fauna observation data to the DCCEEW.	Within 3 months of activity completion.	Upload via the online Cetacean Sightings Application at: https://data.marinemammals.gov.au/nmmdb	N/A – EPBC Act

8.12.1.3 Environment Plan Review

A member of the Beach Environment Team may determine that an internal review of the EP may be necessary based on any one or all of the following factors:

- Changes to hazards and/or controls identified in the review of the EP, which in itself is supported by:
  - Reviewing changes to AMP management arrangements (through subscription to the AMP email update service at https://parksaustralia.gov.au/marine/about/).
  - Environment and industry legislative updates (through subscriptions to NOPSEMA, APPEA and legal firms).

- Running a new EPBC Act PMST for the EMBA to determine whether there are newly-listed threatened species or ecological communities in the EMBA.
- Remaining up to date with new scientific research that may impact on the EIA/ERA in the EP (for example, through professional networking and APPEA membership).
- Remaining in regular contact with stakeholders.

- Implementation of corrective actions to address internal or external inspection or audit findings;
- An environmental incident and subsequent investigation identifies issues in the EP that require review and/or updating;
- A modification of the activity is proposed that is not significant but needs to be documented in the EP;
- Changes identified through the MoC process, such as hazards or controls, organisational changes affecting personnel in safety critical roles or OEMS; and
- Changes to any of the relevant legislation.

The Environment Team provides advice to the Project Manager on the material impact of the items listed previously and whether or not a review of the EP should be undertaken. The scope of a review is determined by the factors that trigger the review and an appropriate team will be assembled by the Principle Environmental Advisor to conduct the review. The team may consist of representatives from the Community, Engineering, HSE, Operations or Supply Chain teams as required by the scope.

All personnel can propose changes to HSE documentation via a register located in the Document Management System. If a review of the EP is initiated, then any proposed changes held in the register will also be considered by the review team.

If a review of the EP relates to a topic that had previously been raised by a stakeholder, an updated response to affected stakeholders will be prepared and provided to affected stakeholders in a process managed by the Community Manager.

Revisions Triggering EP Re-submission

Beach will revise and re-submit the EP for assessment as required by the OPGGS(E) regulations listed in Table 8-10.

Table 8-10: EP revision submission requirements

Regulations	OPGGS(E) regulation
Submission of a revised EP before the commencement of a new activity	17(1)
Submission of a revised EP when any significant modification or new stage of the activity that is not provided for in the EP is proposed	17(5)
Submission of a revised EP before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk not provided for in the EP	17(6)
Submission of a revised EP if a change in titleholder will result in a change in the manner in which the environmental impacts and risks of an activity are managed	17(7)

Revisions and re-submission of the EP generally centre around 'new' activities, impacts or risks and 'increased' or 'significant' impacts and risks. Beach defines these terms in the following manner:

- **New** impact or risk – one that has not been assessed in Chapter 7.

- **Increased** impact or risk – one with greater extent, severity, duration or uncertainty than is detailed in Chapter 7.
- **Significant** change –
  - The change to the activity design deviates from the EP to the degree that it results in new activities that are not intrinsic to the existing Activity Description in Chapter 3.
  - The change affects the ability to achieve ALARP or acceptability for the existing impacts and risks described in Chapter 7.
  - The change affects the ability to achieve the EPO and EPS contained in Chapter 7.

A change in the activities, knowledge, or requirements applicable to the activity are considered to result in a 'significant new' or 'significant increased' impact or risk if any of the following criteria apply:

- The change results in the identification of a new impact or risk and the assessed level of risk is not 'Low', acceptable and ALARP;
- The change results in an increase to the assessed impact consequence or risk rating for an existing impact or risk described in Chapter 7; and
- There is both scientific uncertainty and the potential for significant or irreversible environmental damage associated with the change.

While an EP revision is being assessed by NOPSEMA, any activities addressed under the existing accepted EP are authorised to continue. Additional guidance is provided in NOPSEMA Guideline *When to submit a proposed revision of an EP* (N04750-GL1705, Rev 1, January 2017).

Minor EP Revisions

Minor revisions to this EP that do not require resubmission to NOPSEMA will be made where:

- Minor administrative changes are identified that do not impact on the environment (e.g., document references, contact details, etc.).
- A review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, as outlined in Table 8.9.

Minor revisions to the EP will not be submitted to the regulators for formal assessment. Minor revisions will be tracked in the document control system.

8.12.1.4 Inspections and Audits

Various inspections and audits will be undertaken for the activity using competent personnel, as outlined in Table 8-11. Any non-compliances or opportunities for improvement identified at the time of an inspection or audit will be communicated to the relevant Beach and contractor personnel at the time of the inspection or audit. These are tracked in the Beach incident management system, which includes assigning responsibilities to personnel to manage the issue and verify that it is closed out.

A summary of the EP commitments for the activity will be distributed aboard the vessels (including role-specific checklists), and implementation of the EPS will be continuously monitored by the Beach Offshore Representative and verified by the Beach Principal Environmental Advisor (offshore) (or delegate) through review of the completed weekly checklists and attendance at relevant meetings.

Table 8-11: Summary of environmental inspections and audits

Type	When	Frequency	Method	Details
HSE due diligence inspection	Post-award, pre-activity	Once	Desktop or in port/ during mobilisation	Focused on ensuring EPS can be met through review of relevant records and databases
EP compliance audit	Post-award, pre-activity	Once	In person on board	A suitably experienced auditor will assess compliance against each EPS through interviews, observations and review of databases and records.
Ongoing informal inspections	During activity	Weekly	In person on board	Checklists provided by Beach to be completed by the Beach Offshore Representative.

Non-compliances and/or opportunities for improvement will be communicated to activity personnel in writing and at appropriate meetings (as listed in Table 8-3).

8.12.1.5 Regulatory Inspections

Under Part 5 of the OPGGS Act, NOPSEMA inspectors have the authority to enter Beach premises, including the activity vessel, to undertake monitoring or investigation against this EP. Beach will cooperate fully with the regulator during such investigations.

8.12.1.6 End of Activity Performance Report

In accordance with the OPGGS(E) Regulation 14(2), Beach will submit an end-of-activity EP performance report to NOPSEMA within three months of completion of the activity. Performance will be measured against the EPO and EPS outlined in Chapter 7. The information in the report will be based on the information collected during routine

8.13 Summary of Implementation Strategy Commitments

Table 8-12 summarises the commitments provided throughout this Implementation Strategy by assigning EPOs, EPS and measurement criteria to each commitment.

Table 8-12: Summary of activity implementation strategy commitments

Section	EPO	EPS	Measurement criteria
8.4.2	All records relevant to implementation of the EP are available for five years.	All records relevant to implementation of the EP are stored in 'BoardWalk'.	EP documents are readily accessible through BoardWalk.
8.5.1	Activity personnel are trained and competent to fulfil their duties.	The LMS records and tracks core and critical HSE and technical compliance training.	Training records are readily accessible through the LMS.
		Due diligence is undertaken on contractors to ensure they are competent to work on the activity.	Contractor due diligence reports are readily available and verify their suitability to work on the activity.
8.5.1	Activity personnel are familiar with their HSE responsibilities.	All personnel working on the activity vessel are inducted into the activity HSE requirements.	Vessel crews and visitor lists, along with induction familiarisation checklists are readily available, verifying that all personnel working on and visiting the vessels are inducted.

Section	EPO	EPS	Measurement criteria
8.5.2 & 8.5.3	Activity personnel are familiar with operations HSE issues.	Regular HSE communications take place between vessel- and office-based personnel.	HSE meeting records are available and verify regularity of communications.
8.6 & 8.7	The vessel meets maritime standards and has in place the required MARPOL certifications.	Beach will undertake a due diligence inspection of the vessel to ensure it meets are required maritime standards and has all required environmental certifications (see also Section 3.5.1).	A due diligence inspection report is available and verifies that the vessel meets required maritime standards.
8.8.1	Changes to approved plans (including this EP), equipment, plant, standards or procedures are assessed through the MoC process.	Changes are documented in accordance with the MoC Directive.	MoC records are available in the Stature database.
8.9.1	The EP is reviewed for currency in light of any changes to the activity, controls, legislation or relevant scientific research.	Beach Environment Team updates the EP as required.	The revision history of this EP is updated to record document changes.
8.9.2	Emergency response responsibilities are clearly defined.	A Bridging ERP will be prepared to link between Beach's EMP and the vessel contractor's vessel-specific ERP.	Bridging ERP is in place prior to the activity commencing.
8.9.2	Vessel- and office-based personnel are familiar with their emergency response responsibilities.	All relevant vessel- and office-based personnel participate in emergency response (e.g., ERP and OPEP) training, drills and exercises.	Training records verify that emergency response exercises were undertaken.
8.10.1	Incident reports are issued to the regulators as required.	Recordable incidents reports are issued monthly to NOPSEMA as per Table 8.5.	Recordable and reportable incident reports and associated email correspondence is available to verify their issue to NOPSEMA (and other agencies, as required).
		Reportable incidents are reported to NOPSEMA in accordance with the timing requirements provided in Table 8.6.	
8.10.1.3	Incidents are investigated.	Incident investigations are undertaken by suitably qualified and experienced personnel in a timely manner.	Incident investigation reports are available and align with incidents recorded in the CMS incident management system.
8.11.1.1	Use of MMOs aboard the CSV	MMOs will be hired for the activity to be present on the CSV throughout the activity duration.	MMO daily reports verified and completed by lead MMO.
		The MMO will provide an information session to all vessel crew regarding their fauna observation duties and the communication protocols required.	Vessel crew induction and attendance sheets verify information session was conducted.
8.12.1.1	Emissions and discharges from the vessels are recorded.	Emissions and discharges from the vessels, in line with Table 8.7, are recorded.	Monitoring records are available and align with the requirements in Table 8.7.
8.12.1.2	Regulatory agencies and stakeholders are aware of activity start and end.	Pre- and post-activity notifications to regulatory agencies and stakeholders are issued as per Table 8.8.	Notification records verify issue.
8.12.1.3	This EP is reviewed and updated on an as-required basis.	This EP is reviewed and updated based on the triggers presented in Section 8.12.1 on an as-required basis.	A record of EP reviews and updates is available in BoardWalk.
			The review and/or update details are recorded in the document control page of this EP.

Section	EPO	EPS	Measurement criteria
		If the review identifies that significant changes to the EP are required, the EP (and OPEP, if required) is updated and re-issued to the regulators.	A record of EP revision is included in the document control page of this EP.
			Associated correspondence is available to verify the re-issue of the EP to NOPSEMA.
8.12.1.4	EP compliance inspections and audits are undertaken for the activity.	EP compliance is assessed pre-activity and during the activity by competent personnel.	Environmental inspection reports, completed checklists and audit report are available and verify compliance with this EP.
8.12.1.6	An end-of-activity EP performance report is submitted to NOPSEMA.	The end-of-activity EP performance report is issued to NOPSEMA within three months of completion of the activity.	The end-of-activity EP performance report and associated email correspondence is available to verify its issue to NOPSEMA.

9 Oil Pollution Emergency Plan

The following OPEP provides an overview of Beach's arrangements for responding in a timely manner to an MDO spill during the activity. The OPEP is presented as an EP chapter rather than a stand-alone document in recognition of the fact that the CSV is not classified as a 'facility' in Section 15 and Schedule 3 of the *OPGGS Act 2006* because it:

- Does not rest on the seabed;
- Is not fixed or connected to the seabed; and
- Is not attached or tethered to a facility, structure or installation.

Because the activity vessel is not a 'facility', for oil spill response purposes, it is treated as any other vessel under legislation such as the *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth), Australian *Maritime Safety Authority Act* 1990 (Cth) and the *Navigation Act* 2012 (Cth). It is therefore suitable to describe the spill response arrangements provided at the Commonwealth and state levels for responding to hydrocarbon spills (described in Section 9.1).

In the event of an MDO spill, the Vessel Master will assume onsite command, will make the initial regulatory notifications to AMSA as defined in Section 9.3 and will act as onsite coordinator directed by AMSA. All persons aboard the vessel will be required to act under the direction of the Vessel Master.

The CSV will have equipment on board for responding to emergencies, including but not limited to medical equipment, firefighting equipment and oil spill response equipment as defined in the vessel SMPEP.

In accordance with the Bridging ERP, the Vessel Master will notify the Beach EMT Leader of the emergency, with the EMT Leader acting as onshore liaison. Beach has insurance policies in place that will cover the costs of any clean-up or remediation activities following a spill, no matter the jurisdiction.

9.1 Oil Spill Response Arrangements

In order to encompass the nature and scale of the activity and respond to the identified worst case credible spill scenario, modelling of a loss of 603.7 m^3 of MDO has been undertaken and the risks assessed (Section 7.16). This OPEP has been developed based on the results of this modelling and encompasses multiple levels of planning and response capability. The spill scenario is considered to be very conservative because vessel tanks are never filled 100% full, fuel will have already been combusted to reach the activity area, there are no emergent features to collide into and vessel-to-vessel collisions (resulting in a spill) are extremely rare.

The overall OPEP for the activity comprises the following emergency plans:

- The National Plan for Maritime Environmental Emergencies ('NatPlan') (AMSA, 2020) – AMSA is the jurisdictional authority and control agency for spills from vessels originating in or affecting Commonwealth waters;
- The Victorian State Maritime Emergencies (Non-search and Rescue) Plan (VicPlan') (EMV, 2016) – the Department of Jobs, Precincts and Regions (DJPR) is the Control Agency for spills that affect Victorian State Waters;
- The Tasmanian Marine Oil and Chemical Spill Contingency Plan ('TasPlan') (EPA, 2019) – the Tasmanian Environment Protection Authority (EPA) is the Control Agency for spills from vessels that affect Tasmanian State waters;
- Vessel SMPEP – for spills contained on the vessel or spills overboard that can be managed by the vessel;
- Bridging ERP (described in Section 8.9.2);

- Beach's EMP (described in Section 8.9.2);
- Beach's Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (OPEP) (CDN/ID S4100AH717907); and
- Beach's Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908).

9.1.1 National Plan Summary

The NatPlan is an integrated government and industry framework that seeks to enable effective response to marine pollution incidents and maritime casualties. In accordance with the polluter pays principles of the OPRC 1990, the framework provides for industry as the Control Agency for all spills that originate from offshore petroleum facilities (e.g., platforms, drill rigs). NOPSEMA collaborates closely with AMSA, as the manager of NatPlan, to ensure that arrangements under NatPlan, the OPGGS Act and associated regulations are aligned and understood.

As stated in Section 4.4 of the NatPlan (AMSA, 2020), for all marine pollution incidents that do not originate from a petroleum facility, AMSA is the Control Agency for spills that cannot be managed locally (i.e., Level 2 or 3 spills). Guidance for spill classification, as noted in Part 5 of the NatPlan (AMSA, 2020) is provided in Table 9-1.

Table 9-1: Guidance for spill incident classification

Characteristic	Level 1	Level 2	Level 3
Jurisdiction	Single	Multiple	Multiple, including international
Agencies	First response (e.g., vessel only)	Multiple	Agencies across government and industry
Resources	From within one area (e.g., vessel)	Intrastate	National or international resources
Type of response	First-strike	Escalated	Campaign
Duration	Single shift	Multiple shifts (days to weeks)	Extended (weeks to months)
Environment at risk	Isolated impacts, natural recovery within weeks	Significant impacts, recovery may take months, remediation required	Significant area of impacts, recovery may take months, remediation required

As stated in Section 2.5 of the NatPlan, maritime environmental emergencies have the potential to impact upon the interests of two or more Australian jurisdictions, where each jurisdiction has legitimate administrative and regulatory interests in the incident (for this activity, this includes Victoria). The Australian Government established the Offshore Petroleum Incident Coordination (OPIC) framework for coordinating a whole-of-government response to a significant petroleum incident in Commonwealth waters. The framework interfaces with other emergency incident response/coordination arrangements, including the NatPlan, titleholder OPEPs and State/ Territory marine pollution contingency plans as appropriate. In the case of this activity, AMSA would liaise with the Victorian DJPR (for example) to determine which agency is best placed to take the lead.

In Commonwealth waters, initial spill response actions will be undertaken by the vessel with subsequent actions determined in consultation with regulatory authorities under the NatPlan. AMSA is the responsible Combat Agency for hydrocarbon spills from vessels in Commonwealth waters; upon notification of a Level 2 or 3 spill, AMSA will assume control of the incident.

9.1.2 Victorian Arrangements

In the event that the MDO spill crosses into Victorian state waters, DJPR will only assume Incident Control over the impacted area in State waters while AMSA will remain responsible for managing the spill outside Victorian coastal waters.

If an incident affecting wildlife occurs in Commonwealth waters close to Victorian State waters, AMSA will request support from DELWP to assess and lead a wildlife response if required. DELWP may also place a DELWP Liaison Officer in a state-based oil spill IMT and/or the Beach ERT.

In the event DJPR is leading an oil spill response within Victorian state waters, a joint IMT will be established between DJPR and AMSA. The joint IMT aims to ensure a coordinated response between lead agencies. Beach will have a representative embedded within the joint team and provide feedback to the Beach EMT.

As noted in the Victorian Animal Emergency Welfare Plan (DJPR/DELWP, 2019, Rev 2), DELWP will be the Control Agency for a wildlife response, using arrangements included in the Wildlife Response Plan for Marine Pollution Emergencies (DELWP, 2017).

9.1.3 Tasmanian Arrangements

Under the *Pollution of Water by Oil and Other Noxious Substances Act 1987* (Tas), the Tasmanian EPA is responsible for responding to oil and chemical spills in Tasmanian state waters.

In the event that an MDO spill in Commonwealth waters crosses into Tasmanian state waters, the EPA will only assume Incident Control over the impacted area in State waters while AMSA will remain responsible for managing the spill outside Tasmanian coastal waters in consultation with the State.

The Tasmanian Oiled Wildlife Response Plan ('WildPlan') is administered by the Resource Management and Conservation Division of DPIPWE and outlines priorities and procedures for the rescue and rehabilitation of oiled wildlife.

9.1.4 Vessel SMPEP

MARPOL Annex I requires a SMPEP to be carried on all vessels >400 gross tonnes. In general, a SMPEP describes the steps to be taken:

- In the event that a hydrocarbon spill has occurred;
- If a vessel is at risk of a hydrocarbon spill occurring, and
- For notification procedures in the event of a hydrocarbon spill occurring and provides all important contact details.

The Vessel Master is in charge of implementing the SMPEP and ensuring that all crew comply with the plan.

Vessel SMPEPs include vessel-specific procedures for managing a fuel spill. The SMPEP includes information about initial response, reporting requirements and arrangements for the involvement of third parties having the appropriate skills and facilities to effectively respond to oil spill issues. The SMPEP will be the principal working document for the vessel and crew in the event of an MDO spill. The SMPEP describes specific emergency procedures including steps to control discharges for bunkering spills, hull damage, grounding and stranding, fire and explosion, collisions, vessel list, tank failure, sinking and vapour releases. The SMPEP also includes requirements for regular emergency response drills of the plan and revisions following drills or incidents.

Priority actions in the event of an MDO spill are to:

Make the area safe;

Stop the leak (source control); and

Ensure that further spillage is avoided.

All deck spills will be cleaned-up immediately, using appropriate equipment from the onboard spill response kits to minimise any likelihood of discharge of hydrocarbons or chemicals to the sea.

The Vessel Master is responsible for activating and implementing the vessel SMPEP, the shipboard ERT is responsible for both prevention and response activities with detailed instructions for the team being listed in the vessel SMPEP.

Specifically, the SMPEP provides the following:

- A description of all actions to be taken by onboard personnel to reduce or control the discharge following an MDO spill;
- A detailed description of all spill response equipment held onboard the vessel, including what equipment is available and where it is stored;
- Detailed diagrams of the vessel, including locations of drainage systems, location of spill response equipment and general layout of the vessel;
- An outline of the roles and responsibilities of all onboard personnel with regard to MDO spills;
- A description of the procedures and contacts required for the coordination of MDO spill response activities with the relevant Commonwealth and state agencies; and
- Requirements for testing of the SOPEP and associated drills.

Beach will conduct a desktop oil spill response exercise with the vessel contractor prior to the activity commencing (see Section 9.4).

9.1.5 Victorian Offshore OPEP

Oil spill response arrangements associated with this activity are supported by Beach's Victorian Offshore Oil Pollution Emergency Plan (OPEP) (CDN/ID 18986979/VIC 1000 SAF PLN) (submitted to NOPSEMA with the EP). The risk of an MDO spill from this activity (Section 7.16) was reviewed against the Victorian Offshore OPEP.

9.1.6 Offshore Victoria OSMP

Operational and scientific monitoring arrangements associated with this activity are supported by Beach's Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and the Thylacine Subsea Installation and Commissioning Installation EP OSMP Addendum (CDN/ID S4111AF725810) (both submitted to NOPSEMA with the EP). Further detail on operational and scientific monitoring is included in Section 9.7.

9.2 Spill Response Options Assessed

Spill response mitigation measures will be implemented as appropriate to reduce the likelihood of impacts to key marine environmental receptors (see Section 7.17.1 for the spill response strategy). The objectives of spill response include the protection of human health, environmental values, and the protection of assets.

The selection of spill response techniques in any situation will include an operational net environmental benefit analysis (NEBA) to confirm the suitability of the strategic spill response NEBA. The operational NEBA would be jointly conducted between AMSA and Beach and will take into account priorities for protection and sensitivity of the receptors at risk, as well as operational limitations including the amount and availability of equipment, access to competent personnel, logistical support, access, maintaining equipment deployments, waste management and weather conditions.

9.2.1 Preferred Spill Response

A number of response options have been assessed specific to the activity location, fuel type and spill modelling results, which are outlined in Section 7.17.1. These are:

- Source control – locating the source of the leakage and isolating the tanks and transferring fuel to slack or empty tanks (where safe to do so);
- Monitor and evaluate the trajectory and extent of the spill; and
- Assisted natural dispersion using propeller wash, if advised by the Control Agency that it is safe to do so.

Initial actions for source control are outlined in the vessel SMPEP and would be undertaken in consultation with the relevant Combat Agency (initially AMSA, given the activity's location in Commonwealth waters).

These spill response activities are not expected to introduce additional hazards to the marine environment or to result in significant additional potential impacts. The response options of source control, monitor and evaluate and assisted natural dispersion will use the construction vessel, and the potential impacts associated with the use vessels is evaluated throughout Chapter 7.

9.3 Spill Notifications

The Vessel Master has the responsibility for reporting overboard spills to the AMSA Response Coordination Centre (RCC) (via POLREP Form contained in the vessel's SMPEP).

Once this initial report has been undertaken, further reports (SITREP forms) will be issued from the vessel at regular intervals to keep relevant parties (such as AMSA, NOPSEMA, etc.) informed. The Beach Offshore Representative is responsible for advising the Beach Project Manager of the spill incident. The Beach Project Manager is then responsible for notifying NOPSEMA.

Regulatory notification arrangements are provided in Table 9-2. In addition to this, Beach will advise potentially affected stakeholders of the spill.

Table 9-2: MDO spill regulatory notifications

Notification timing	Authority	Notification By	Contact Number	Details
Level 1				
ASAP	Beach PM	Vessel Master	TBA	Vessel to notify Beach immediately or ASAP to ensure further notifications can be undertaken
ASAP	DNP	Beach PM	0419 293 465	Beach to verbally notify the DNP via the Marine Park Compliance Duty Officer in the event that a spill may enter an AMP.
Within 2 hours	AMSA	Vessel Master	1800 641 792	Verbally notify AMSA RCC of spill. Follow up with written POLREP ASAP. http://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/Contingency/Oil/documents/Appendix7.pdf

Notification timing	Authority	Notification By	Contact Number	Details
Within 2 hours	NOPSEMA	Beach PM	08 6461 7090	Beach to verbally notify NOPSEMA of spill >80L http://www.nopsema.gov.au/assets/Guidance-notes/N-03000-GN0926-Notification-and-Reporting-of-Environmental-Incidents-Rev-4-February-2014.pdf
Level 2 or 3 (in addition to Level 1 notifications)				
ASAP - if spill affects Vic Waters	DJPR	AMSA/ Beach PM	03 8392 6934	Verbally notify DJPR and follow up with POLREP ASAP
ASAP – if spill affects Tas Waters	DPIPWE	AMSA/ Beach PM	03 6165 4599	Verbally notify DPIPWE and follow up with POLREP ASAP
Within 2 hours	Type II Monitoring Service Provider (RPS)	Beach PM	08 9211 1111	Verbally notify service provider to initiate scientific monitoring if triggered (as outlined in Section 9.7.2).
Within 1 day	NOPTA	Beach PM	08 6+424 5317	Provide a verbal or written incident summary.
Within 3 days	NOPSEMA	Beach PM	08 6461 7090	Provide a written incident report form.
If MDO is travelling towards one or more AMPs				
ASAP	Director of National Parks	Beach PM	0419 293 465	Spill with potential to impact AMPs, including potential for oiled wildlife. Provide: • Titleholder details; • Time and location of the incident (including name of AMP likely to be affected); • Proposed response arrangements as per the OPEP; • Confirmation of provision of monitoring and evaluation reports when available; and • Contact details for the response coordinator.

9.4 Spill Response Testing Arrangements

The vessel SMPEP includes provision for testing emergency drills (in accordance with Regulation 14(8A)(8C) of the OPGGS(E)). Furthermore, a test of the oil spill emergency response arrangements referred to in this EP will be conducted:

- When they are introduced;
- When they are significantly amended;
- Not later than 12 months after the most recent test; and
- If and when a new vessel is engaged for the activity.

Prior to commencing the activity, spill response arrangements applicable to the CSV will be tested. 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. Any actions will be recorded and tracked to completion.

The test will audit the onboard spill response capability against the SMPEP to verify spill preparedness and ensure vessel personnel are familiar with required actions.

9.5 OPEP Review

In accordance with OPGGS(E) Regulation 14(8), the OPEP must be kept up to date. A review of the OPEP occurs on an annual basis and is revised as required. Any of the following factors may trigger a revision of the OPEP:

- Changes to hazards and/or controls identified in the EP;
- Changes to response and/or monitoring capability;
- Outcomes from annual testing of the response arrangements;
- Revision of emergency management procedures;
- When major changes that may affect the oil spill response coordination or capabilities have occurred;
- After an actual emergency if gaps are identified within the plan;
- Change in state or Commonwealth oil spill response arrangements and resources; and
- Before installing and commissioning new plant and equipment (if risk profile changes).

9.6 Cost Recovery

In the event of a hydrocarbon spill, Part 6.1A of the OPGGS Act states that titleholders are required to eliminate or control the spill, clean up the spill and remediate any environmental damage and undertake environmental monitoring of the impact of the spill. The Act also states that any costs incurred by NOPSEMA and Commonwealth and state/Territory government agencies must be reimbursed by the titleholder.

Part 1B of the OPGGS(E) specifies that titleholders are required to maintain sufficient financial assurance to meet the costs, expenses and liabilities that may result from a worst-case event associated with its offshore activities. In the case of this activity, this most credible such event would be a large scale MDO spill. Financial assurance must be demonstrated to NOPSEMA before the EP can be accepted.

Beach has insurance policies in place that will cover the costs of spill response and operational and scientific monitoring (see the following section).

9.7 Operational and Scientific Monitoring

Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and the Thylacine Subsea Installation and Commissioning Installation EP OSMP Addendum (CDN/ID S4111AF725810) (both submitted to NOPSEMA with the EP).

Monitoring appropriate to the nature and scale of the spill will be determined based on the hydrocarbon characteristics, the size and nature of the release (e.g., slow continuous release or instantaneous short duration release), weathering characteristics (dispersion and dilution rates), the location of the spill and the modelled trajectory of the spill. There are two types of monitoring considered, discussed in detail below.

9.7.1 Type 1 Operational Monitoring

As the Control Agency, AMSA is responsible for initiating an appropriate level of Type I Operational Monitoring using NatPlan resources to monitor the spill and any response effort, if required.

Operational monitoring may include spill surveillance and tracking to validate oil spill trajectory modelling. Beach may, at the direction of the Control Agency, support Type I monitoring with on-the-water surveillance to:

- Determine the location and extent of a spill;

- Track the movement and trajectory of the spill;
- Identify receptors at risk; and
- Determine sea conditions and potential constraints to spill response activities.

This monitoring will also enable the Vessel Master to provide information to the relevant Combat Agency (AMSA), via a POLREP/SITREP form, to allow for determination and planning of appropriate response actions under the NatPlan (if required).

Operational monitoring and observation in the event of a spill will inform an adaptive spill response and, if required, will support the identification of appropriate scientific monitoring of relevant key sensitive receptors.

Specific monitoring/data requirements for Type 1 monitoring may include:

- Estimation of sea state;
- Estimation of wind direction and speed;
- Locating and characterising any surface slicks;
- GPS tracking;
- Manual or computer predictions of oil trajectory and weathering; and
- GIS mapping.

Determining the location and characterisation of surface slicks will likely be restricted to daylight hours only, when surface slicks will be visible from the activity vessel. Evaluations of sea state and weather conditions from the vessel/s will continue until this function is taken over by the Combat Agency. The information gathered from this initial monitoring will be passed on to the Combat Agency, via the POLREP form, but also via ongoing SITREP reports following the initial spill notification to AMSA RCC.

Beach will implement, assist with, or contribute to (including funding if required) any other Type I monitoring (e.g., computer OSTM) as directed by the Combat Agency.

9.7.2 Type II Scientific Monitoring

In consultation with the Control Agency, Beach is committed to scientific monitoring dependent on the circumstances of the spill, and the sensitivities at risk. Beach's OSMP describes the detailed arrangements and studies that could be activated upon request and agreement with AMSA. The OSMP ensures Beach has a capability to undertake Type II scientific monitoring if required and also enable the chosen service provider to act (in a capacity as agreed with all parties) to either assist the Control Agency or to undertake key Type II monitoring activities on Beach's behalf (if initiation criteria are triggered).

Beach will work with AMSA and relevant stakeholders to develop and implement appropriate scientific monitoring. The aim of the scientific monitoring is to understand the environmental impacts of the spill and response activities on the marine environment, with a focus on relevant environmental and social values and sensitive receptors.

The scientific monitoring program outlined in the OSMP has been developed to ensure that it is sufficient to inform any remediation activities and is consistent with monitoring guidelines and methodologies such as CSIRO (2016).

The scientific monitoring may comprise some or all of the monitoring studies described in Table 9-3 and detailed in Section 5 of the Beach OSMP. As described previously, Beach will engage with AMSA to coordinate and review operational monitoring data. Operational monitoring may provide valuable surveillance and modelling data to confirm the predicted extent and degree of MDO exposure and impacts. This data will then be used to determine if scientific monitoring of relevant key sensitive receptors may be of value in the longer term to evaluate environmental impacts and recovery of affected receptors. The requirement for, and design of scientific monitoring studies will be based on desktop/technical studies and/or field investigations, in order to ensure they are feasible and will obtain relevant information based on available monitoring data, the nature of the receiving environment and results of the consultation process.

Table 9-3 summarises Beach's OSMP scientific monitoring studies. If triggered, a detailed monitoring plan for each study will be developed in line with the OSMP. It is noted that where termination criteria for a study includes comparison to appropriate thresholds of concern, those thresholds will be confirmed and specified in the monitoring plan.

If deemed necessary, following consultation with the Combat Agency and relevant stakeholders, Beach will activate its contract with its OSMP provider (RPS) to design and implement the appropriate scientific monitoring studies as outlined in the Beach OSMP. RPS has undertaken a wide range of relevant marine environmental monitoring studies in Australia and internationally and has the relevant skills, expertise and resources in place to provide scientific monitoring support. RPS prepares a monthly OSMP readiness review for Beach outlining the resources available to undertake OSMP requirements.

Initiation criteria for scientific monitoring studies are outlined throughout Section 5 of the Beach OSMP. Following Beach's notification to RPS that a spill has occurred, RPS will make the necessary preparations for the potentially required monitoring studies.

Table 9-3: Scientific monitoring program summary

Scientific Monitoring	Objectives	Initiation triggers	Termination criteria
SM01 Water quality impact assessment	Determine the impact to, and recovery of; offshore and intertidal water quality from oil exposure and/or any impacts to associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from the Study O2 has confirmed exposure to offshore or intertidal waters **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that: ◦ MDO concentrations in offshore waters have returned to within the expected natural dynamics of baseline state and/or control sites **or** ◦ MDO concentrations in offshore waters are below relevant ANZG (2018) 99% species protection levels or other applicable benchmark values **and** • The EMT Environment Leader (or delegate) considers that: ◦ Relevant water quality parameter concentrations in offshore waters have returned to within the expected natural dynamics of baseline state and/or control sites **or** ◦ Relevant water quality parameter concentrations in offshore waters are below relevant ANZG (2018) 99% species protection levels or other applicable benchmark values **and** • The EMT Environment Leader (or delegate) in conjunction with relevant government agency, considers that water quality values within protected areas (i.e., AMPs, Ramsar wetlands or State marine protected areas) have not been impacted or have returned to within the expected natural dynamics of baseline state **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring
SM02 Sediment quality impact assessment	Determine the impact to, and recovery of, offshore, intertidal and shoreline sediment quality from oil exposure and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred and data from the Study O3 has confirmed exposure to shoreline sediments **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that: ◦ MDO concentrations in sediments have returned to within the expected natural dynamics of baseline state and/or control sites **or** ◦ MDO concentrations in sediments are below relevant ANZECC/ARMCANZ SQGV other applicable benchmark values **and** ◦ Relevant sediment quality parameter concentrations have returned to within the expected natural dynamics of baseline state and/or control sites **or** ◦ Relevant sediment quality parameter concentrations in are below relevant ANZECC/ARMCANZ SQGV other applicable benchmark values **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.
SM03 Subtidal habitats impact assessment	Determine the impact to, and recovery of, subtidal habitats from oil exposure and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from the OPEP Monitor and Evaluate response strategy or Study O2 or O3 indicates potential and/or actual exposure to near-bottom waters or sediments **or**	• The EMT Environment Leader (or delegate) considers that disturbance parameters (e.g., species composition, percent cover) and health parameters (e.g., leaf condition) have returned to within the expected natural dynamics of baseline state and/or control sites **and** • The EMT Environment Leader (or delegate) in conjunction with relevant government agency, considers that subtidal habitat quality values within protected areas (i.e., AMPs, Ramsar wetlands or State marine protected areas) have not been

Scientific Monitoring	Objectives	Initiation triggers	Termination criteria
		• The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	impacted or have returned to within the expected natural dynamics of baseline state **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.
SM04 Intertidal and coastal habitats impact assessment	Determine the impact to, and recovery of, intertidal and coastal habitats from oil exposure and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from the OPEP Monitor and Evaluate response strategy or Study O2 or O3 indicates potential and/or actual exposure to near-bottom waters or sediments **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that disturbance parameters (e.g., species composition, percent cover) and health parameters (e.g., leaf condition) have returned to within the expected natural dynamics of baseline state and/or control sites **and** • The EMT Environment Leader (or delegate) in conjunction with relevant government agency, considers that intertidal habitat quality values within protected areas (i.e., Ramsar wetlands or State marine protected areas) have not been impacted or have returned to within the expected natural dynamics of baseline state **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.
SM05 Marine fauna impact assessment	Determine the impact to, and recovery of, marine fauna from oil exposure and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from the Study O4 has confirmed exposure to marine fauna **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that disturbance parameters (e.g., population size, breeding success) have returned to within the expected natural dynamics of baseline state and/or control sites **and** • The EMT Environment Leader (or delegate) in conjunction with relevant government agency, considers that protected marine fauna (i.e., threatened or migratory species) have not been impacted or have returned to within the expected natural dynamics of baseline state (including any assessment against management requirements in Conservation Advices and/or Recovery Plans) **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.
SM06 Fisheries impact assessment	Determine the presence of, and recovery from, oil taint in commercially or recreationally important fish species and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from Study O6 has confirmed the presence of fishing tainting **or** • Allegations of damage are received from commercial fisheries or government agencies **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that: ◦ Fish or shellfish show no presence of tissue taint **or** ◦ PAH levels in fish and shellfish tissue have returned to within the expected natural dynamics of baseline state and/or control sites **or** ◦ PAH levels in fish and shellfish tissue are at or below regulatory levels of concern **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.

Scientific Monitoring	Objectives	Initiation triggers	Termination criteria
SM07 Heritage and socio-economic impact assessment	Determine the impact to, and recovery of, heritage and socioeconomic features from oil exposure and/or any impacts associated with response activities.	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from the OPEP Monitor and Evaluate response strategy or Study O2 or O3 indicates potential and/or actual exposure to known areas of heritage or socioeconomic features **or** • Allegations of damage are received from other users (e.g., tourism operators, heritage groups) or government agencies **or** • The EMT Environment Leader (or delegate) advises that either full or partial implementation of the study is to commence.	• The EMT Environment Leader (or delegate) considers that considers that disturbance parameters (e.g., hydrocarbon visibility and concentration, condition/quality, area usage levels) have returned to within the expected natural dynamics of baseline state and/or control sites **and** • The EMT Environment Leader (or delegate) in conjunction with relevant government agency, considers that heritage and/or socioeconomic features have not been impacted or have returned to within the expected natural dynamics of baseline state **and** • Agreement has been reached with the Statutory Authority relevant to the spill to terminate the monitoring.

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Appendices

Appendix A Fair Ocean Access Information Sheet

Fair Ocean Access

Minimising fishing impacts from offshore operations

beach

Information Sheet | May 2021

Introduction

Licenced commercial fishers and petroleum title holders have lawful rights and obligations to carry out their activities safely and without interference. Beach is committed to *Fair Ocean Access* by minimising impacts from its offshore activities to commercial fishers.

Beach's *Fair Ocean Access Procedure* sets out commitments by Beach to genuine consultation with fishers to understand and minimise safety, environmental and economic impacts.

Where impacts cannot be minimised by Beach, and a fisher has acted to avoid risks and impacts to a Beach project, Beach's *Fair Ocean Access Procedure* includes a simple and fair process for a fisher to claim compensation for an economic loss, and a rapid approval and payment process.

Safety

Safety is Beach's first priority and operating safely will sometimes require restricted access for relatively small offshore areas over short periods. Beach will consult with fishers to seek to minimise potential disturbance to areas that are regular fishing grounds and where the fisher has no alternative fishing options.

Environmental Protection

Beach's projects are subject to stringent assessment and mitigation of potential environmental impacts. Beach must prepare Environment Plans for its offshore projects. These identify all environmental and socio-economic impacts and set out mitigation measures to reduce impacts, so they are "as low as reasonably practicable" and acceptable by regulators. Mitigation measures may include compensation where impacts on the commercial fishing industry cannot be minimised and where these impacts cause an economic loss.

Assessment of impacts includes identifying State and Commonwealth commercial fisheries that are actively fished in Beach's project areas and any biological or economic impacts to those fisheries. Consultation with commercial fishers is an important part of Beach's environmental assessment process.

Genuine consultation

Beach will consult with openness, transparency and mutual respect with fishers who may be directly impacted by Beach's projects. Beach will use its best endeavours to consult with all potentially impacted fishers during preparation of its Environment Plan for a project, and before projects commence.

Respecting the representative role of fishing associations, Beach will seek engagement with potentially impacted fishers via the relevant association. Beach will also engage directly with a fisher if they are not a member of an association, or where they request direct engagement with Beach.

Where a fishing association or fisher believes they will be impacted by a Beach project, Beach will share its fishing impact assessments, validate that with fishers, and discuss their specific circumstances with the objective of minimising potential impacts.

If project avoidance and impact minimisation is not possible, Beach will provide a copy of its full *Fair Ocean Access Procedure* and discuss mitigation options set out in the procedure, as appropriate to the individual fisher or association.

Economic loss

Beach is committed to the principle that a fisher should not suffer an economic loss as a direct result of a Beach project. Losses may occur for different reasons such as:

- reduced catch from fishing in a new area in order to avoid a Beach project
- reduced catch due to impacts to a fishery from the project activities
- steaming costs to avoid a Beach project area
- costs to repair or replace fishing gear.

Acting in good faith

Beach is committed to a fair, simple and transparent process for a fisher to claim compensation, where the fisher has consulted with Beach in good faith before a project, and provided the fisher has:

- acted to avoid risks and impacts to a Beach project
- acted to mitigate any economic losses to their business that may arise from avoiding risks and impacts to a Beach project
- evidence of fishing in the Beach project area during the same time of year as the project timing, for at least three years within the last five years, unless there are genuine fishery or fishing practice reasons for lesser periods
- historical and current catch and effort evidence and the ability to demonstrate an economic loss, as set out in Beach's *Fair Ocean Access Procedure*.

Making a claim

The *Fair Ocean Access Procedure* sets out a simple claim form and describes the evidence required for a claim, such as historical catch and effort records, current catch and effort records, and fish prices.

Claims must be made within 60 days of completion of a Beach project unless there is evidence that the project has caused an impact to the fishery which has impacted future catch and caused an economic loss.

The *Fair Ocean Access Procedure* sets out timeframes for the rapid assessment and payment of successful claims and for ensuring the fisher is kept informed.

Beach will nominate a single point of contact at Beach for a fisher to liaise with.

Claims and evidence will be managed in accordance with Beach's Privacy Policy which can be found on Beach's website.

If a claim is not approved, Beach will provide written reasons for the decision.

Resolving disagreements

Where a fisher and Beach cannot agree on a fisher's claim, the *Fair Ocean Access Procedure* includes steps for appointing an independent expert to resolve the matter. Beach will pay the reasonable costs of the independent expert, as set out in the *Fair Ocean Access Procedure*.

We welcome your questions and feedback

P: 1800 959 562
E: community@beachenergy.com.au

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Appendix B EPBC Act Protected Matters Search Reports

Activity Area EMBA

Underwater Noise EMBA

Light EMBA

Spill EMBA – Socio-economic

Appendix C Acoustic Modelling Report

Appendix D RPS Oil Spill Trajectory Modelling Report