Environment Plan

Geographe Subsea Installation & Commissioning (VIC/L23)

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

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Appendices

Number	Title
1	Assessment of activity against the aims of marine park management plans
2	Assessment of activity against the aims of threatened species' management plans
3	Stakeholder consultation flyer
4	Stakeholder communications (provided to NOPSEMA separately as sensitive information under regulation 9(8) of the OPGGS(E))
5	EPBC Act Protected Matters Search Tool results
6	Otway Basin Environmental Survey
7	Sound Transmission Loss Modelling Report

Abbreviations

Acronym	Definition
AANRO	Australian Agricultural and Natural Resource Online
ABS	Australian Bureau of Statistics
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office

AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AMA	Alternative Muster Area
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AMSA JRCC	Australian Maritime Safety Authority Joint Rescue Coordination Centre
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
ARMCANZ SQGV	Agriculture and Resource Management Council of Australia and New Zealand - Sediment Quality Guideline Value
APASA	Asia-Pacific Applied Science Associates
APIA	Australian Pipeline Industry Association
APPEA	Australian Petroleum Production and Exploration Association
AQIS	Australian Quarantine Inspection Service
ARS	Area restricted search
AS	Action Statement
AS/NZ	Australian/New Zealand
AUV	Autonomous Underwater Vehicles
Bar(g)	Gauge pressure
BAT	Best Available Technique/s
BBG	Bowman Bishaw Gorham
BIA	Biologically important areas
BOD	Basis of Design
BOM	Bureau of Meteorology
BPEM	Best Practice Environmental Management
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BWMC	Ballast Water Management Certificate
BWMP	Ballast Water Management Plan
BWRS	Ballast Water Record System
BWR	Ballast Water Report
CA	Conservation Advice
CAMBA	China-Australia Migratory Bird Agreement
CCPS	Critical Control Performance Standard
CCR	Central Control Room
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CER	Commission for Energy Regulation

CERI	Collaborative Environmental Research Initiative
CFC	Chlorofluorocarbons
CH_4	Methane
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973
CFS	Country Fire Service
CFSR	Climate Forecast System Reanalysis
CFT	Critical Function Testing
CMID	Common Marine Inspection Document
CMMS	Computerised Maintenance Management System
CMO	(Beach Incident) Management (system)
CMP	Conservation Management Plan
CMR	Commonwealth Marine Reserve
CMT	Crisis Management Team
CO	Carbon monoxide
CO_2	Carbon dioxide
CoEP	Code of Environmental Practice
COLREG	Convention on the International Regulations for Preventing Collisions at Sea 1972
CP	Cathodic Protection
CRA	Corrosion Resistant Alloy
CRG	Community reference group
CSA	Cetacean Sightings Application
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Construction support vessel
Cth	Commonwealth
CTS	Commonwealth Trawl Sector
CV	Curriculum Vitae
CVI	Close Visual Inspection
d	Day
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water and the Environment (Cth)
DAWR	Australian Department of Agriculture and Water Resources
DC	Direct current
DCS	Distributed Control System
DEDJTR	Department of Economic Development, Jobs, Transport and Resources (Vic) (*former*)
DEW	Department for Environment and Water (Cth) (*former*)
DIT	Department of Transport and Infrastructure (SA)
DJPR	Department of, Jobs, Precincts and Regions (Vic)
DELWP	Department of Environment, Land, Water and Planning (Vic)

DN	Nominal diameter
DNV	Det Norske Veritas
DoE	Department of the Environment (Cth) (former)
DoEE	Department of the Environment and Energy (Cth) (former)
DNP	Director of National Parks
DO	Dissolved Oxygen
DoA	Department of Agriculture
DP	Dynamic positioning
DPIPWE	Department of Primary Industries, Parks, Water & Environment
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Cth)
DTI	Department for Trade and Investment (SA)
EAC	East Australian Current
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Lead
EHFL	Electrical Hydraulic Flying Lead
EIA	Environment Impact Assessment
EIAPP	Engine International Air Pollution Prevention
EIS	Environmental Impact Statement
EMAC	Eastern Maar Aboriginal Corporation
EMBA	Environment that May Be Affected
EMP	Emergency Management Plan
EMT	Emergency Management Team
EMV	Emergency Management Victoria
ENSO	El Niño – Southern Oscillation
EP	Environment Plan
EPA	Environmental Protection Authority (Vic)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPIRB	Emergency Position Indicating Radio Beacon
ePAR	Electronic Pre-Arrival Report
EPO	Environmental Performance Objective
EPS	Environmental Performance Standard
E&P	Exploration and Production
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
ESD	Emergency Shutdown
ESDV	Emergency Shutdown Valve

FFG Act	Flora and Fauna Guarantee Act 1988 (Vic)
GAB	Great Australian Bight
GMDSS	Global Maritime Distress Safety System
GHG	Greenhouse Gas
GMP	Garbage Management Plan
GRT	Gross Register Tonnes
GSACUS	Great Southern Australian Coastal Upwelling System
GVI	General Visual Inspection
HAZID	Hazard Identification
HFC	High Frequency Cetacean
HFC	Hydrofluorocarbons
HFL	Hydraulic Flying Lead
HFO	Heavy Fuel Oils
HPU	Hydraulic Power Unit
HSE	Health Safety and Environment
HSEMS	Health, Safety and Environment Management System
HVAC	Heating, ventilation and air-conditioning
IAFS	International Anti-Fouling System
IAP	Incident Action Plan
IAPP	IAPP, International Air Pollution Prevention
IBC	Intermediate Bulk Container
ICS	Integrated Control System
ID	Inside Diameter
IEE	International Energy Efficiency
IMCA	International Marine Contractors Association
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMDG	International Marine Dangerous Goods
IMO	International Maritime Organisation
IMOS	Integrated Marine Observing System
IMS	Invasive Marine Species
IMSMP	Invasive Marine Species Management Plan
IOGP	International Association of Oil & Gas Producers
IOPP	International Oil Pollution Prevention
IPIECA	International Petroleum Industry Environmental Conservation Association
IPP	International Pollution Prevention
IR	Infra-red
ISO	International Standards Organisation
ISPP	International Sewage Pollution Prevention

ISQG	Interim Sediment Quality Guidelines
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
JSA	Job Safety Analysis
JVP	Joint Venture Partner
KEF	Key Ecological Features
KPI	Key Performance Indicator
LFC	Low Frequency Cetacean
LGA	Local Government Area
LLGP	Lang Lang Gas Plant
LoC	Loss of Containment
LoWC	Loss of Well Control
LPG	Liquefied Petroleum Gas
MAOP	Maximum Allowable Operating Pressure
MARPOL	IMO International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)
MARS	Maritime Arrivals Reporting System
MCR	Maximum Continuous Ratings
MD	Managing Director
MDO	Marine Diesel Oil
MFC	Medium Frequency Cetacean
MEG	Mono-Ethylene Glycol
MMO	Marine Mammal Observer
MMSCFD	Million Standard Cubic Feet per Day
MNES	Matter of National Environmental Significance
MNP	Marine National Park
MO	Marine Order
MoC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOV	Manual Operated Valve
MP	Marine Park
MPa	Megapascal(s)
MSDS	Material Safety Data Sheet
MV	Marine vessel
N_2O	Nitrous oxide
NA	Not applicable
NC	No contact
NCEP	National Centre for Environmental Prediction

NCVA	National Conservation Values Atlas
NDT	Non-destructive Testing
NEBA	Net Environmental Benefits Analysis
NIW	Nationally important wetland
NGER	National Greenhouse and Energy Reporting
NMFS	US National Marine Fisheries Service
NMSC	National Marine Safety Committee
NNTT	National Native Title Tribunal
NO_2	Nitrogen dioxide
NOEC	No Observed Effect Concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administration
NOAA	National Oceanic and Atmospheric Administration (US)
NOO	National Oceanographic Office
NORM	Naturally Occurring Radioactive Materials
NP	National Park
NSW	New South Wales
NTM	Notice to Mariners
NUI	Normally Unmanned Installation
O_3	Ozone
OCNS	Offshore Chemical Notification Scheme
OD	Overall diameter
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer
OEM	Operations Excellence Management System
OGP	Otway Gas Plant
OGPP	Otway Gas Production Pipeline
OGUK	Oil and Gas United Kingdom
OIW	Oil In Water
OPGGS(E)	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)
OPGGS Regulations	Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Vic)
OPIC	Offshore Petroleum Incident Coordination
OMS	Operating Management System
OPRC	Oil Pollution Preparedness, Response and Cooperation
OPEP	Oil Pollution Emergency Plan
ORP	Oxidation-reduction potential
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oslo and Paris Commission

OSRA	Oil Spill Response Atlas
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
OWS	Oily Water Separator
PA/GA	Public Address and General Alarm
PAH	Polyaromatic hydrocarbons
PAM	Passive Acoustic Monitoring
PCB	Polychlorinated biphenyls
PCM	Pipeline Corrosion Monitoring
PCS	Process Control System
PFW	Produced Formation Water
P&ID	Piping and Instrumentation Diagrams
PIC	Person In Charge
PL	Pipeline licence
PLONOR	Pose Little or No Risk
PM	Project Manager
PMP	Primary Muster Point
PMS	Planned Maintenance System
PMST	Protected Matters Search Tool
PMV	Production Master Valve
POB	Person On Board
POLREP	(Marine) Pollution Report
POSPOPS Act	Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth)
POWBONS Act	Pollution of Waters by Oil and Noxious Substances Act 1986 (Vic)
PPE	Personal Protective Equipment
PPL	Petroleum Production Licence
PSZ	Petroleum Safety Zones
PTS	Permanent Threshold Shift
PTW	Permit To Work
PSV	Pressure Safety Valve
PVC	Polyvinyl chloride
PWV	Production Wing Valve
RBI	Risk Based Inspection
RCC	Response Coordination Centre
RESDV	Riser Emergency Shutdown Valve
RGP	Raw Gas Pipe
RO	Reverse Osmosis
ROKAMBA	Republic of Korea–Australia Migratory Birds Agreement

ROV	Remotely Operated Vehicle
RP	Recovery Plan
RWP	Relief Well Plan
SA	South Australia
SAMSCAP	South Australia Marine Spill Contingency Action Plan
SCM	Subsea Control Module
SCSSV	Surface Controlled Subsurface Safety Valve
SDU	Subsea Distribution Unit
SDS	Safety Data Sheets
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMR	South-East Marine Region (Cth)
SES	State Emergency Service
SESSF	Southern and Eastern Scalefish and Shark Fishery
SF_6	Sulfur hexafluoride
SHK	Species or habitat known to occur in the area
SHM	Species or habitat may occur in the area
SHS	Scalefish Hook Sector
SHX	Subsea Heat Exchanger
SITHP	Shut-in Tubing Head Pressure
SITREP	Situation Report
SIS	Safety Instrumented System
SM	Scientific Monitoring
SMC	Subsea Manifold Cooler
SMPEP	Shipboard Marine Pollution Emergency Plan
SO_2	Sulfur dioxide
SO_X	Sulphur oxides
SOPEP	Shipboard Oil Pollution Emergency Plan
SPCU	Subsea Power and Control Unit
SPL	Sound Pressure Level
SPS	Sanitary and Phytosanitary
SPRAT	Species Profile and Threats (database)
SRT	State Response Team
SST	Sea surface temperature
SSSV	Sub-Surface Safety Valve
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STLM	Sound Transmission Loss Modelling
STP	Sewage Treatment Plant

SST	Sea Surface Temperature
SRW	Southern right whale
SVS	Subsea Valve Skid
TACC	Total Allowable Commercial Catch
Tas	Tasmania
TasPlan	Tasmanian Marine Oil and Chemical Spill Contingency Plan
TEC	Threatened Ecological Communities
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
TFS	Tasmanian Fire Service
TOLC	Top of Line Corrosion
TPC	Third Party Contractor
TRH	Total recoverable hydrocarbon
TSS	Total suspended solids
TTS	Temporary Threshold Shift
TUTU	Topside Umbilical Termination Unit
TRSC-SSSV	Tubing Retrievable Surface Controlled Sub-Surface Safety Valve
TSSC	Threatened Species Scientific Committee
UHF	Ultra-High Frequency
UNFCCC	United Nations Framework Convention on Climate Change
UNCLOS	United Nations Convention on the Law of the Sea 1982
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEP IE	United Nations Environment Programme Industry and Environment
UTA	Umbilical Termination Assembly
VBA	Victorian Biodiversity Atlas
VCS	Vertical Connection System
VFA	Victorian Fisheries Authority
VHF	Very High Frequency
VIC/Vic	Victoria
VoO	Vessel/s Of Opportunity
VWMS	Victorian Waterway Management Strategy
WA	Western Australia
WAF	water-accommodated fraction
WET	Whole Effluent Toxicity
WGFM	Wet Gas Flow Meter
WildPlan	Tasmanian Oiled Wildlife Response Plan
WIMP	Well Integrity Management Plan
WMO-GAW	World Meteorological Organisation-Global Atmosphere Watch
WOMP	Well Operations Management Plan

WRSSV	Wireline Retrievable Subsurface Safety Valve
XT	Christmas Tree

Units of Measurement

Abbreviation	Definition
'	Foot/Feet
"	Inch(es)
°C	Degrees Celsius
bbl	Barrel
cui	Cubic Inches
dB	Decibel(s)
g	Gram/s
ha	Hectare/s
hr	Hour/s
kJ	Kilojoule(s)
km	Kilometre
km/hr	Kilometres per hour
km^2	Kilometres squared
kPa	Kilopascal(s)
kPaG	Kilopascal(s) – gauge pressure
L	Litre(s)
m	Metre(s)
m^2	Square metres
m^3	Cubic metres
mg/L	Milligrams per litre
mL	Millilitre(s)
mm	Millimetre
MM	Million
MMbbl	Million barrels
MMscf	Million Standard Cubic Feet
mPa	Megapascal
nm	Nautical Mile(s)
PJ	Petajoule
ppb	Parts per billion
ppm	Parts per million
s	Second(s)
scf	Standard Cubic Foot/Feet
t	Tonne(s)

tcf	Trillion cubic feet
TJ	Terajoule(s)
µg	Microgram(s)
µPa.	Micropascals
V	Volt(s)

1. Introduction

1.1 Background

Beach Energy (Operations) Ltd ('Beach') is the operator of the Geographe gas field located in Production Licence VIC/L23 in Commonwealth waters of the Otway Basin. The Geographe gas field is located in a water depth of approximately 85 metres (m) and is located 55 kilometres (km) south of Port Campbell, Victoria. Beach plans to tie-in production from two new wells to be drilled in the Geographe gas field to the existing Otway Gas Production Pipeline (OGPP). Drilling of these two new wells is not part of this activity and is assessed in a separate EP.

The activities that Beach proposes to undertake that are included in this Environment Plan (EP) are:

- Connection of two subsea christmas trees (XTs) from the Geographe-4 and Geographe-5 wells (to be drilled and completed in Q1-Q2 2021 and addressed in a separate EP) to the existing OGPP via;
    - Installation of two rigid production spools to connect the XTs to the existing Subsea Manifold Coolers (SMC);
    - Connection of new electrical and hydraulic controls from the existing Subsea Distribution Unit (SDU) to the new XTs;
- Commissioning of the newly installed infrastructure;
- Disconnection of the plugged and suspended Geographe-3 to the Subsea Manifold Cooler (SMC) tie-in spool; and
- Disconnection and recovery of Electrical Flying Leads (EFLs) for the Geographe-3 spool Wet Gas Flow Meter (WGFM).

These activities are part of the Otway Phase 4 Development project, which aims to increase gas supply to the Beach-operated Otway Gas Plant (OGP).

The existing Geographe development consists of the following subsea components:

- Two subsea XTs (Geographe-2) and (Geographe-3 – non-production);
- Two SMC adjacent to the subsea XTs;
- One Subsea Valve Skid (SVS) located adjacent to the Geographe Tee (on the OGPP);
- Rigid production tie-in spools between the Subsea XTs and the adjacent SMC, and between the two SMCs;
- Rigid production tie-in spool between SVS and the Geographe Tee;
- Rigid monoethylene glycol (MEG) tie-in spool between SVS and the Geographe Tee;
- Flexible production flowline between SMC and the SVS;
- MEG distribution from the Geographe tee to the subsea XTs via the SVS, infield umbilical, SDU and flying leads; and
- Hydraulic, chemical, electrical and signal distribution from the Thylacine platform via the main umbilical, SDU and flying leads.

The Geographe-3 well was drilled in 2012 and suspended (not completed for production), so its XT and rigid spool have not been exposed to hydrocarbons. Currently the XT and rigid spool are preserved with MEG.

Following the works, production fluids will flow from the existing Geographe-2 well and the new Geographe-4 and Geographe-5 wells to the Geographe tee via the existing flexible flowline to the existing OGPP. The location of the Otway offshore infrastructure is presented in Figure 1.1.

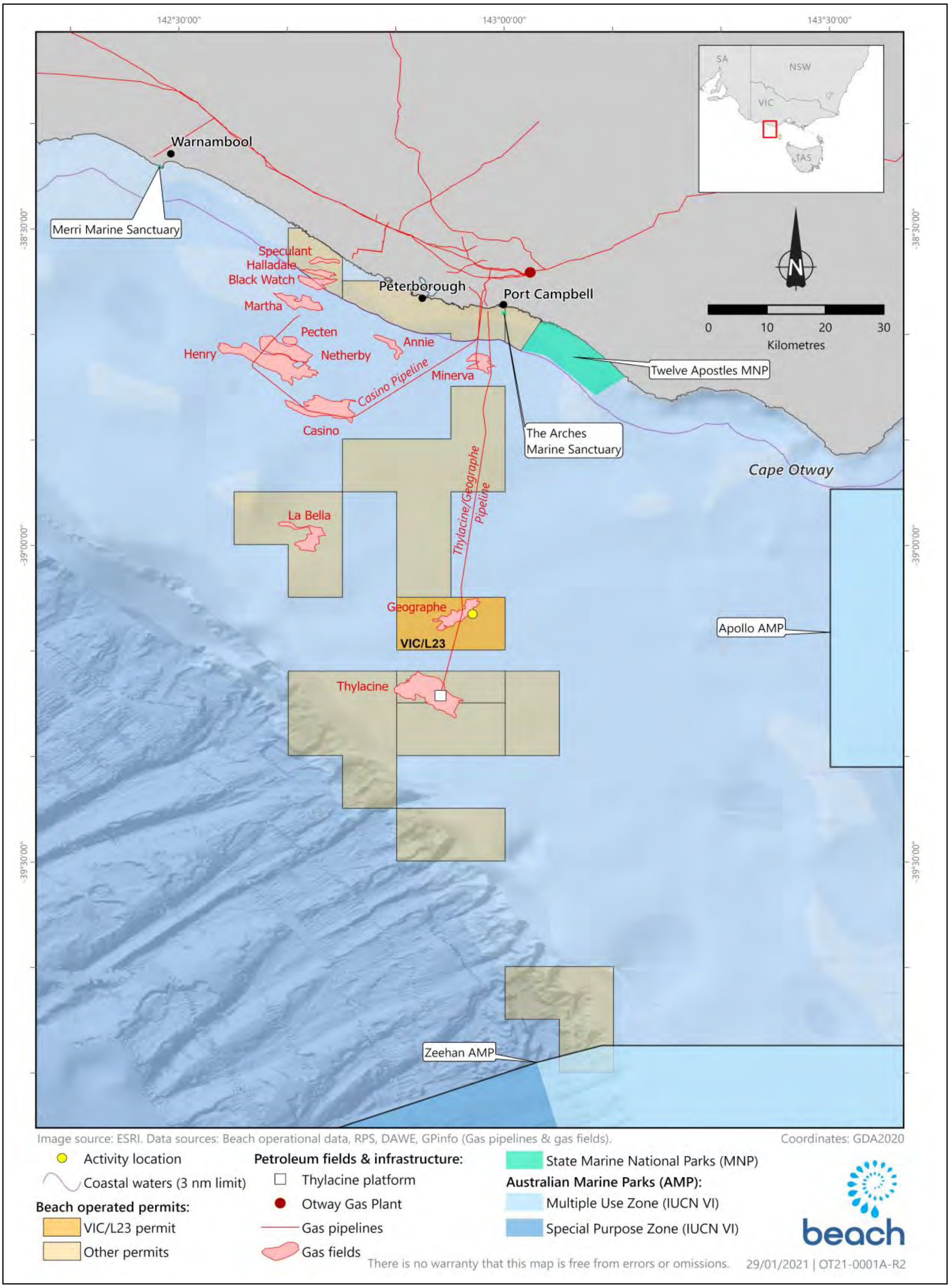


Figure 1.1. Geographe subsea installation & commissioning location map

1.2 Environment Plan Summary

Table 1.1 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 1.1. EP Summary of material requirements

EP Summary requirement	Relevant EP section
The location of the activity	Section 3.1
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)	Refer to OPEP
Consultation already undertaken and plans for ongoing consultation	Chapter 4
Details of the titleholder’s nominated liaison person for the activity	Section 1.3

1.3 The Titleholder

Beach is the titleholder and operator of VIC/L23 on behalf of several joint venture partners. The composition of the permit holdings is presented in Table 1.2.

Table 1.2. Titleholder details for VIC/L23

Titleholder	ABN	Holding
Beach Energy (Operations) Limited	66 007 845 338	55% (Operator)
OGOG (Otway) Pty Ltd	628 946 752	40%
Beach Energy (Otway) Ltd	099 899 395	5%

Beach acquired Lattice Energy Ltd (previously Origin Energy Resources Limited (Origin)) on 31 January 2018. This ownership change follows on from the announcement made by Origin in December 2016 to divest its conventional upstream oil and gas assets in Australia and New Zealand and the subsequent formation of the Lattice group of companies as owner of the conventional upstream assets. Subsequently in January 2020, Beach completed a name change from Lattice Energy to Beach Energy.

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).

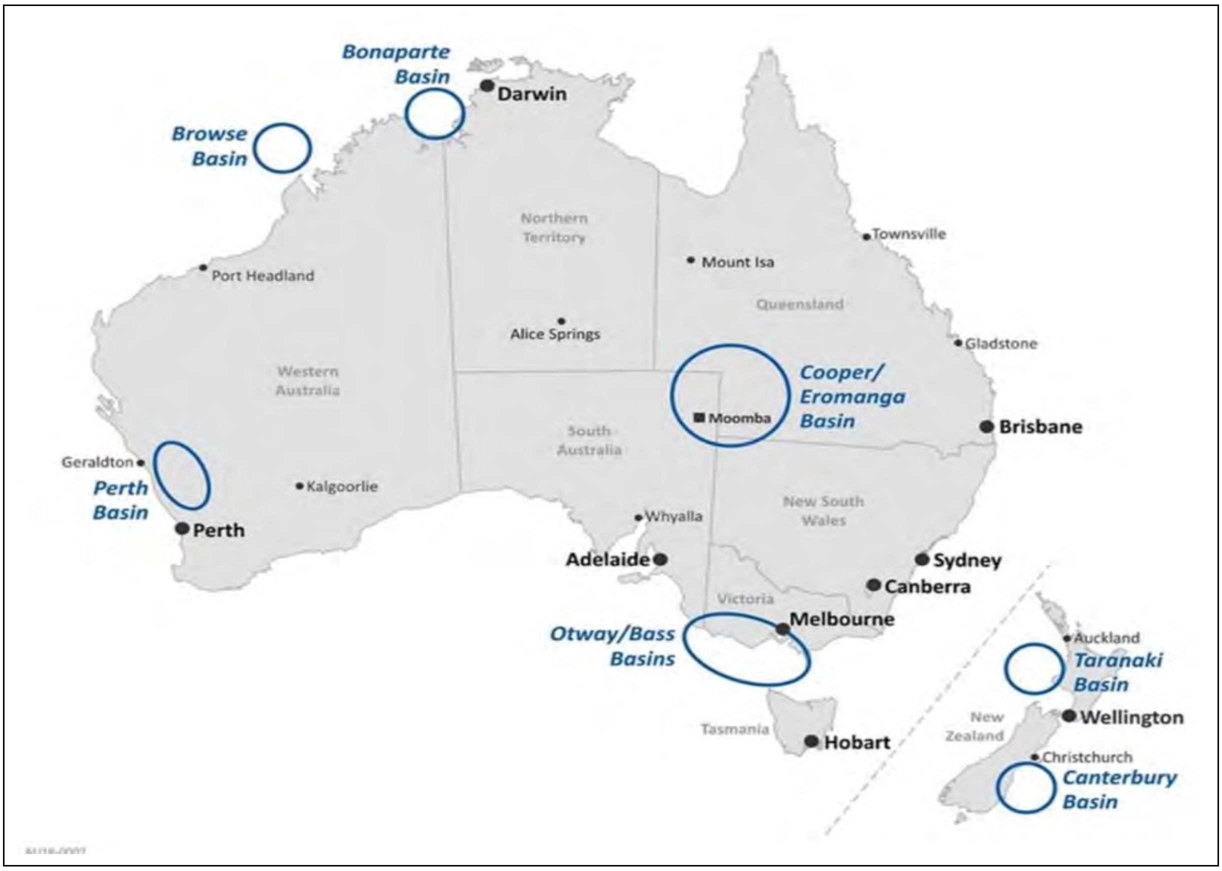


Figure 1.2. Locations of Beach assets

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.

The Titleholder for this activity is:

Beach Energy (Operations) Ltd
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.

1.4 Objectives of this EP

As required by Regulation 6 of the OPGGS(E), an accepted EP must be in place prior to any offshore petroleum activity commencing, and that activity must comply with the accepted EP.

This EP aims to secure acceptance of the Geographe subsea installation campaign by demonstrating that Beach will manage the environmental impacts and risks of the activity to As Low as Reasonably Practicable (ALARP) and to an acceptable level.

1.5 Scope of this EP

This EP includes a description of:

- The nature of the activity (location, layout, operational details);
- The legislative framework relevant to the activity;
- Stakeholder consultation activities;
- The environment affected by the activity;
- Environmental impacts and risks;
- Mitigation and management measures;
- Environmental performance outcomes, standards and measurement criteria;
- How impacts and risks will be reduced to be an acceptable level and ALARP;
- The implementation strategy to ensure that the environmental impacts and risks are managed in a systematic manner; and
- Reporting arrangements.

1.5.1 Definition of the Activity

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 and commissioning of tie-in equipment between Geographe-4 and Geographe-5 to the existing SDU and SMC and removal of the existing Geographe-3 tie-in, 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.*

The ‘activity area’ is defined in Section 3.1.

1.5.2 Jurisdiction

The activity occurs entirely within Commonwealth waters and this EP has been prepared to satisfy the requirements of Part 2 of the OPGGS(E), administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

1.5.3 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);
- Artisan-1 Oil Pollution Emergency Plan (OPEP) (CDN/ID 3973983); 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.

2. Environmental Regulatory 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 Environment Policy

In accordance with Regulation 16(a) of the OPGGS(E), Beach's Environment Policy is provided in Figure 2.1. The policy provides a public statement of the company's commitment to minimise adverse effects on the environment and to improve environmental performance.

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.

2.2 Commonwealth 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.

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

The OPGGS(E) addresses all licensing and environmental issues for offshore petroleum and greenhouse (GHG) activities in Commonwealth waters. This EP has been prepared in accordance with Part 2 of the OPGGS(E) for NOPSEMA's assessment.

The OPGGS(E) requires the preparation of an EP prior to conducting a petroleum activity for acceptance by NOPSEMA. The EP is an activity-specific document that provides a detailed impact and risk assessment and describes how identified risks will be managed. Upon EP acceptance, the activity may commence.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the key legislation regulating projects that may have an impact on matters of national environmental significance (MNES). The Commonwealth Department of Agriculture, Water and the Environment (DAWE) is the regulator of the EPBC Act.

In February 2014, NOPSEMA became the designated assessor of petroleum and GHG activities in Commonwealth waters in accordance with the Minister for the Environment's endorsement of NOPSEMA's environmental authorisation process under Part 10, section 146 of the EPBC Act. Under the streamlined arrangements, impacts on the Commonwealth marine area by petroleum and GHG activities are assessed solely through NOPSEMA. As such, an EPBC Act Referral has not been prepared and submitted to the DAWE for this activity. The requirements of the EPBC Act are addressed in this EP.

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 Environmental Policy

Table 2.1. Summary of key Commonwealth environmental legislation relevant to the activity

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Environmental protection and approvals			
OPGGS Act 2006 and OPGGS (Environment) Regulations 2009	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
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. **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 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. • Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.	DAWE (NOPSEMA in the case of this activity)
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).	DAWE

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Oil spill			
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, 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
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. • 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.	• 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). • 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.	AMSA
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POSPOPS Act) Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994	Regulates ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. It requires that ships >400 gross tonnes have pollution emergency plans. Several MO are enacted under this Act relating to offshore petroleum activities, including: • MO 91: Marine Pollution Prevention – Oil	Various parts of MARPOL. See also Table 2.2 for further information.	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	• 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.		
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
Air quality/GHG			
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
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.	DAWE

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Marine pests			
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 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 DAWE guidelines regarding quarantine clearance to enter Australian waters.	• 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.	DAWE
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
Fisheries management			

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
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
Maritime heritage			
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.	DAWE

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. Since 2017, the EPA no longer regulates domestic ballast water management in Victoria. This has been taken over by the Commonwealth government. This means vessels visiting a Victorian port no longer need to provide ballast water documentation to EPA Victoria, and that ballast water must be managed in accordance with the Commonwealth *Biosecurity Act* 2015 (see Table 2.1).
- *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. Several marine national parks occur within the diesel spill EMBA (entrained phase only, see Section 5.4.9).
- *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 South Australian Legislation

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

- *Emergency Management Act* 2004 – establishes emergency management system in South Australia and the Stat Emergency Management Plan.
- *Environment Protection (Water Quality) Policy* 2016 – defines environmental harm, environmental values, the general environmental duty an offence of polluting waters.
- *National Parks and Wildlife Act* 1972 – gives the Department for Environment and Water the responsibility of dealing within injured (oiled) wildlife.
- *Protection of Marine Waters (Protection of Pollution from Ships) Act* 1987 and Regulations – implements Annex I, II, III and V of MARPOL.
- *Harbours and Navigation Act* 1993 – sets out requirements for Port Operators to have contingency plans and to respond to an emergency.

2.6 Government Guidelines

This EP has been developed in accordance with the NOPSEMA Guidance Note for *Environment Plan Content Requirements* (N04750-GN1344, Revision 4, April 2019). 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, Rev 8, March 2020).

- Reducing marine pest biosecurity risks through good practice biofouling management (NOPSEMA Information Paper N-04750-IP1899, Rev 1, March 2020).
- Environment plan assessment (NOPSEMA Policy, N-04750-PL1347, Rev 8, March 2020).
- Environment plan decision making (NOPSEMA Guideline GL1721, Rev 6, November 2019).
- Environment plan content requirements (NOPSEMA Guidance Note, N-04750-GN1344, Rev 4, April 2019).
- Oil spill modelling (NOPSEMA Environment Bulletin, April 2019).
- Acoustic impact evaluation and management (NOPSEMA Information Paper, N-04750-IP1765, Rev 2, December 2018).
- Petroleum activities and Australian marine parks (NOPSEMA Guidance Note, N-04750-GN1785, Rev 0, July 2018).

OPEPs

- Oil pollution risk management (NOPSEMA Guidance Note GN1488, Rev 2, February 2018).
- 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-04700-IP1349, March 2016).

EPBC Act

- EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (DoE, 2013).

2.7 Government Management Plans

The environmental performance standards (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.

Appendix 1 provides an assessment of the activity against the objectives of marine reserves in the hydrocarbon spill EMBA. Appendix 2 provides an assessment of the activity against the objectives of various Commonwealth-listed threatened species Conservation Advice and Recovery Plans for species that may occur within the hydrocarbon spill EMBA.

2.8 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.

2.8.1 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. It contains six annexes and is in force in 174 countries (as of January 2021).

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).

2.8.2 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.

2.8.3 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.

2.8.4 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)**	**South Australian waters** ***Protection of Marine Waters (Prevention of Pollution from Ships) 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).	Part 3A, Division 2 – 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).	Part 3A, Division 3 – 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	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).	Part 3AA - Prevention of 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)

Annex (entry into force in Australia)	Commonwealth waters (POSPOPS Act 1983 & *Navigation Act* 2012)	Victorian waters (POWBONS Act 1986)	Tasmanian waters (POWBONS Act 1987)	South Australian waters ***Protection of Marine Waters (Prevention of Pollution from Ships) Act* 1987**	General operating requirements
in Packaged Form (1995)					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 • 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).	N/A	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).	Part 3AAB – Prohibition of disposal of garbage in State waters	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;

Annex (entry into force in Australia)	Commonwealth waters (POSPOPS Act 1983 & *Navigation Act* 2012)	Victorian waters (POWBONS Act 1986)	Tasmanian waters (POWBONS Act 1987)	South Australian waters *Protection of Marine Waters (Prevention of Pollution from Ships) Act* 1987	General operating requirements
					• 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 of Greenhouse Gases). • Clause 35 (Management of Ozone Depleting Substances (ODS)). • Clause 36 (Management of other Mobile Sources).	*Environmental Management and Pollution Control Act* 1994 Environmental Protection Policy (Air Quality) 2004	N/A	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 (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.

2.8.5 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).

At February 2021, IOGP's members comprise 77 members, comprising oil and gas exploration and production companies, associations and contractors. 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.

2.8.6 IPIECA Best Practice Guidelines

IPIECA is the International Petroleum Industry Environmental Conservation Association, established in 1974 (since 2002, IPIECA stopped using the full title). At January 2021, IPIECA's members comprise 70 members of oil and gas exploration and production companies, associations and contractors.

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.

2.8.7 ITOPF Oil Spill Response Technical Information Papers

The International Tanker Owners Pollution Federation Limited (ITOPF) was established in 1968 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 (Section 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.

3.1 Activity Objective

The purpose of the activity is to connect gas supply from the Geographe-4 and Geographe-5 wells to the OGP.

3.2 Location

The activity will take place within Beach-operated permit VIC/L23, which is located in Commonwealth waters and covers an area of 132 km^2. The permit is located 40 km south of the nearest Victorian coastline and 55 km south of Port Campbell. The Geographe-4 and Geographe-5 wells are located 14 km north of the Thylacine platform.

The activity area is defined as:

> *A 500-m radius around the existing HE-200 cooler centred at 668 729E 5 669 382N (see Figure 3.4), which encapsulates the Geographe subsea complex, as presented in Figure 3.1.*

The coordinates of the subsea infrastructure at the Geographe field are presented in Table 3.1. The distance of the activity area to key features in the region is presented in Table 3.2.

Table 3.1. Coordinates of Geographe subsea infrastructure in the activity area

Subsea infrastructure	Latitude (S)	Longitude (E)	Easting (m)	Northing (m)
Geographe-2	39° 6' 29.67"	142° 57' 6.20"	668,752	5,669,398
Geographe-3	39° 6' 29.19"	142° 57' 5.81"	668,743	5,669,413
Geographe-4	39° 6' 29.64"	142° 57' 4.03"	668,700	5,669,400
Geographe-5	39° 6' 28.82"	142° 57' 5.05"	668,725	5,669,425
HE-100 (SMC)	39° 6' 29.59"	142° 57' 5.15"	668,727	5,669,401
HE-200 (SMC)	39° 6' 30.21"	142° 57' 5.25"	668,729	5,669,382
SDU-500	39° 6' 30.28"	142° 57' 6.50"	668,759	5,669,379
UTA-500T	39° 6' 31.26"	142° 57' 6.16"	668,750	5,669,349

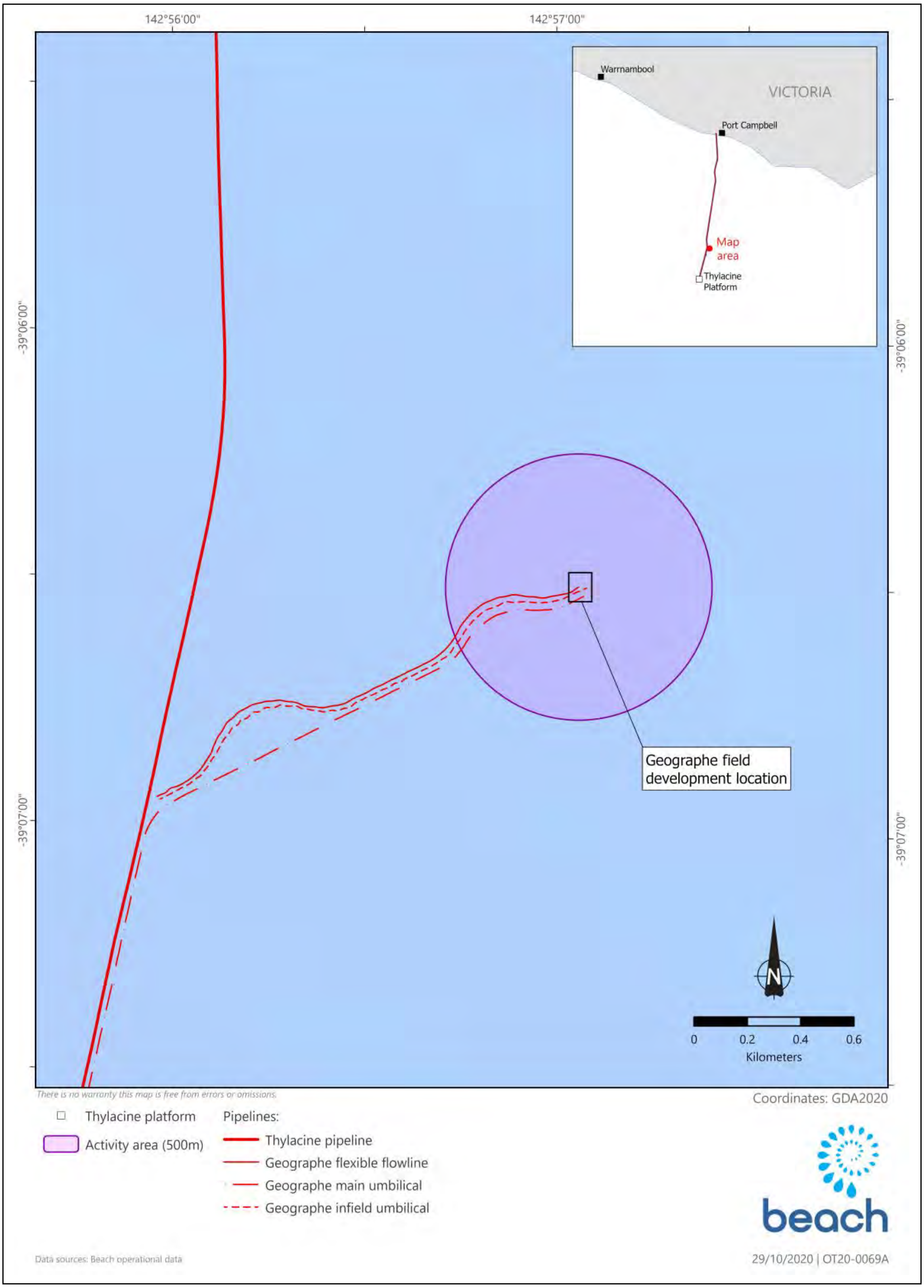


Figure 3.1. Proposed Geographe subsea installations activity area

Table 3.2. Distances to key features from the activity area

Feature	Distance and direction from the activity area to the nearest point of the feature
Towns	
Warrnambool (Vic)	88 km northwest
Port Campbell (Vic)	55 km north
Portland (Vic)	143km northwest
Apollo Bay (Vic)	75 km northeast
Torquay (Vic)	148 km northeast
Flinders (Vic)	194 km northeast
Currie (Tas – King Island)	121 km southeast
Stanley (Tas)	270 km southeast
Natural Features	
Cape Otway	59 km northeast
Lady Julia Percy Island	111 km northwest
Discovery Bay	165 km northwest
Port Phillip Bay (Entrance)	172 km northeast
Westernport Bay (Entrance)	203 km northeast
Tasmanian Mainland	229 km southeast
King Island (Tas)	102 km southeast
Marine Protected Areas	
Commonwealth	
Apollo Australian Marine Park (AMP)	49 km east
Zeehan AMP	77 km south
Nelson AMP	211 km west
Franklin AMP	194 km southeast
Boags AMP	198 km south east
Beagle AMP	314 km east
Victorian – marine	
Twelve Apostles Marine National Park (MNP)	45 km north
Point Addis MNP	133 km northeast
Discovery Bay MNP	160 km northwest
Bunurong MNP	238 km east
Wilsons Promontory MNP	286 km east

Feature	Distance and direction from the activity area to the nearest point of the feature
Victorian – coastal (onshore)	
Great Otway National Park	45 km northeast
Port Campbell National Park	53 km north
Bay of Islands Coastal Park	61 km northwest
Discovery Bay Coastal Park	142 km northwest
Infrastructure	
Otway Gas Plant (onshore)	60 km north-northeast
Thylacine platform	13 km south
Yolla platform	260 km southeast

3.3 Activity Timing

The window of installation for the activity is a four-month period beginning start of July to the end of October 2021. The exact timing of the activity is contingent on the completion of the Geographe-4 and Geographe-5 drilling program and the acceptance of this EP.

The activity is anticipated to take up to 30 days to complete, depending on sea state conditions and technical matters.

This EP describes the EMBA and assesses environmental impacts and risks with no seasonal bias in order to take account of any eventuality with activity start time and duration.

The nominated activity window selected by Beach balances operational requirements with environmental and socio-economic constraints. Figure 3.2 outlines the key ecological processes and species presence in the Otway Basin of Bass Strait throughout the year.

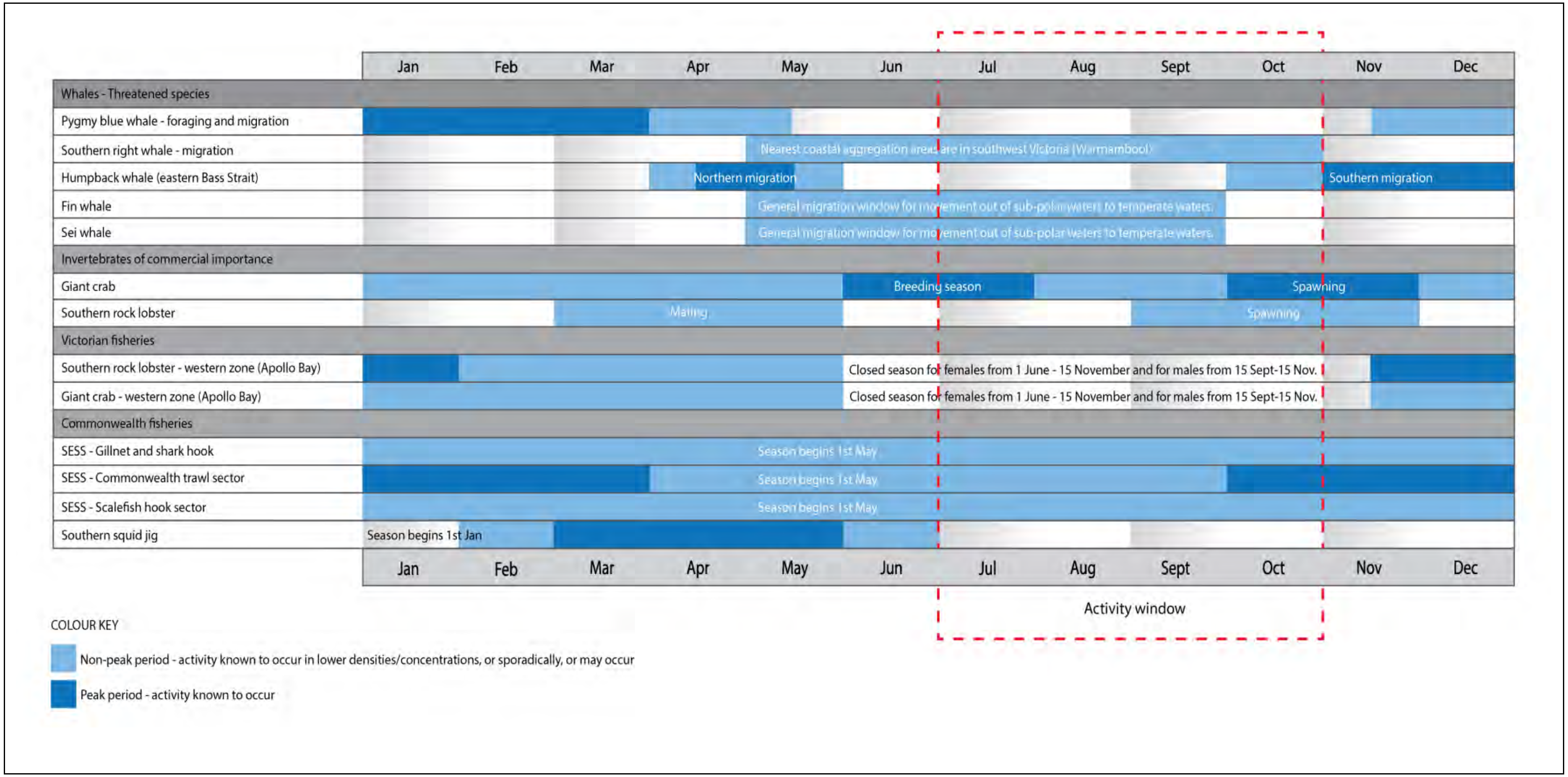


Figure 3.2. Key ecological and socio-economic activities in and around the activity area

3.4 Activity Footprint

The seabed footprint of the Geographe equipment to be installed is listed in Table 3.3.

Table 3.3. Footprint of the Geographe subsea equipment

Element	Individual component	Area
Production spools	Geographe-4 to SMC	~24 m @ 219 mm outside diameter (OD) = 5.27 m^2
	Geographe-5 to SMC	~24 m @ 219 mm OD = 5.27 m^2
HFL	SDU to Geographe-4	~100 m @ 160 mm OD = 16 m^2
	SDU to Geographe-5	~100 m @ 160 mm OD = 16 m^2
EFL	SDU to Geographe-4	~90 m @ 30 mm OD = 2.7 m^2
	SDU to Geographe-5	~90 m @ 30 mm OD = 2.7 m^2
Total:		**~ 47.94 m^2**

The subsea infrastructure to be installed as part of this activity is illustrated in blue in Figure 3.3, with existing infrastructure depicted in black. A detailed plan view of the general arrangement of the equipment to be installed is illustrated in Figure 3.4.

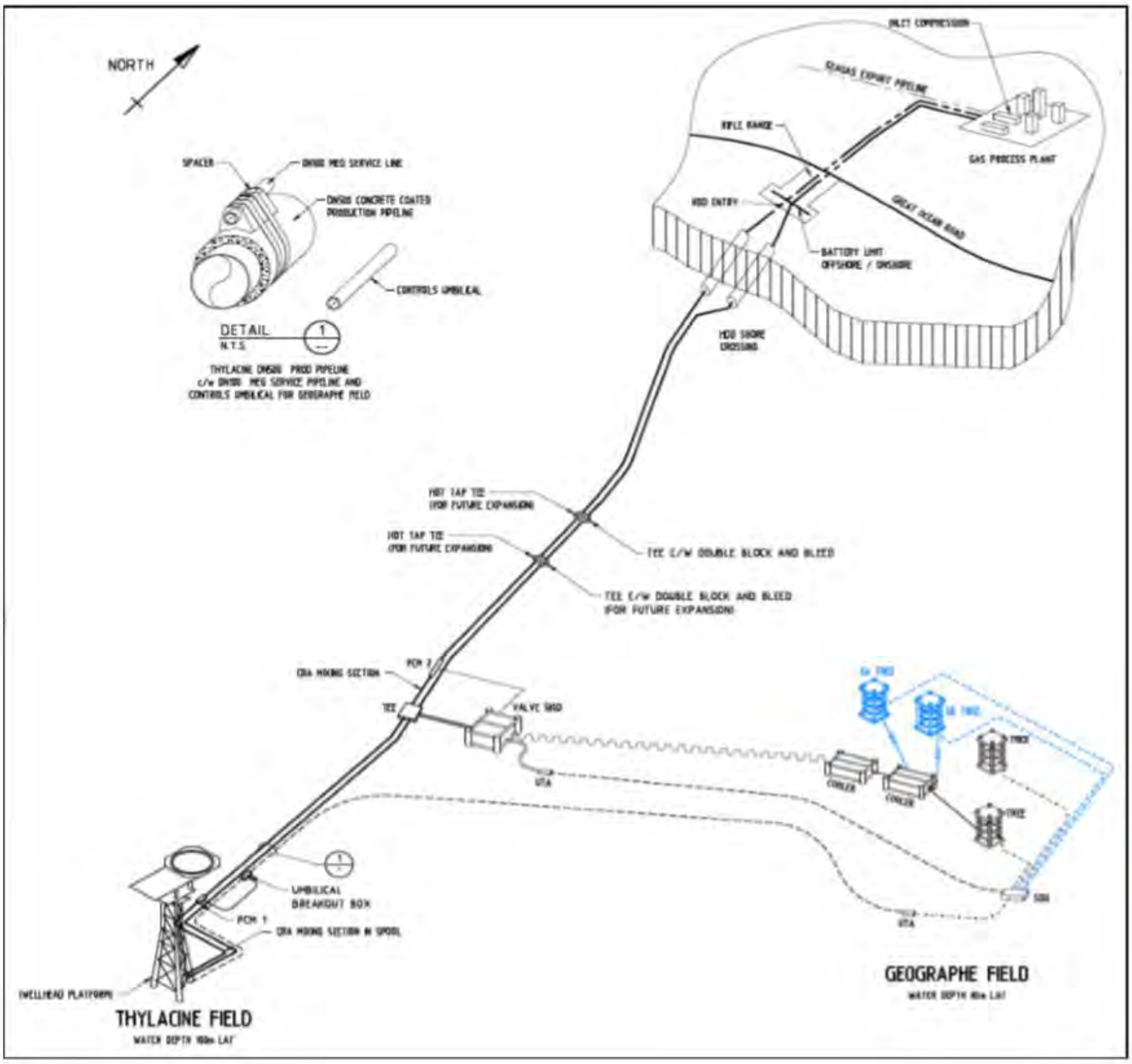


Figure 3.3. Simplified schematic of the Geographe subsea equipment

Note: the G4 and G5 trees will be installed under a separate EP.

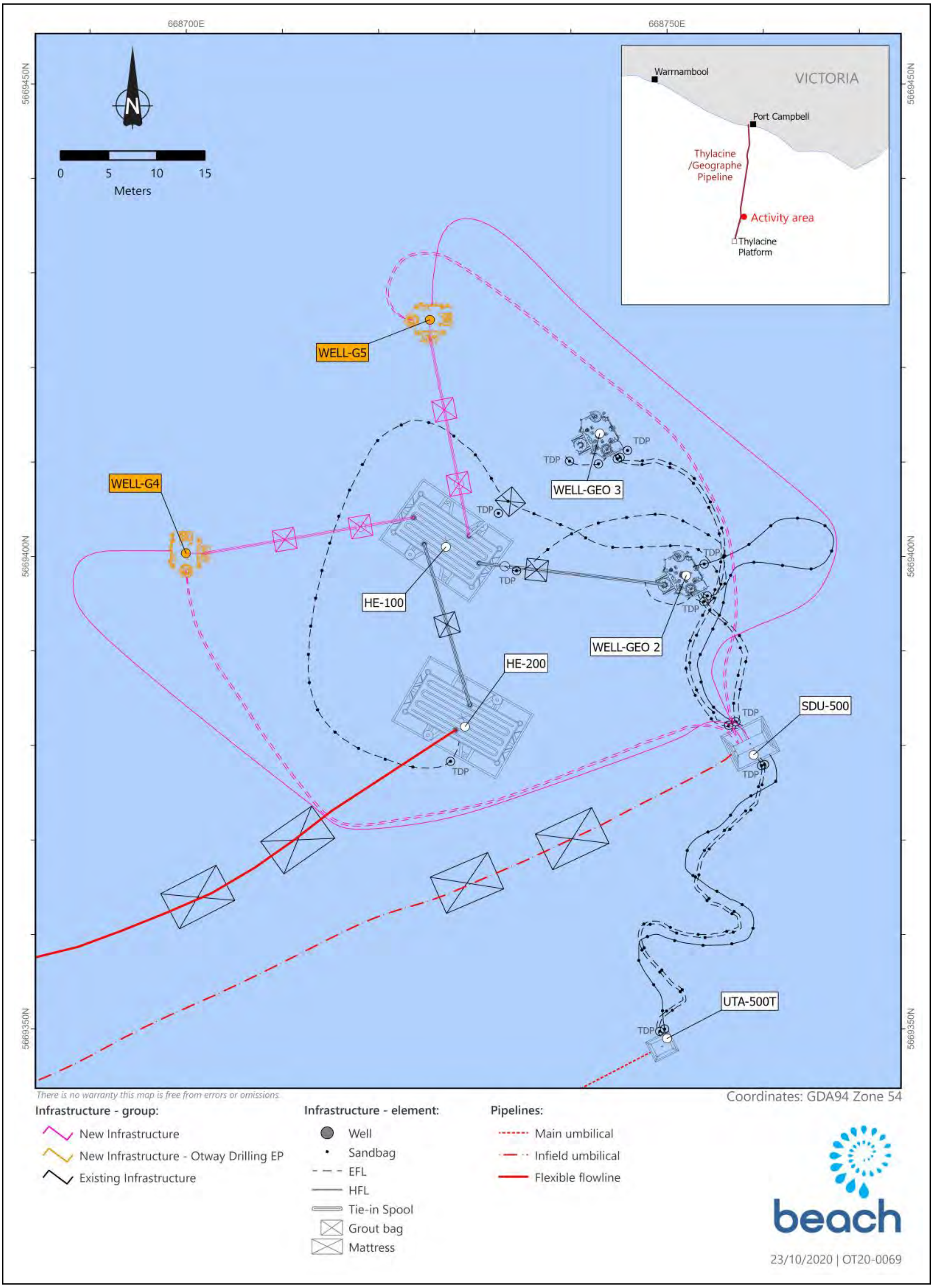


Figure 3.4. General arrangement of the Geographe subsea equipment

3.5 Installation Program

A construction support vessel (CSV) will be used to undertake the installation of the subsea infrastructure. The specifications of a typical CSV are escribed in Section 3.6. The installation roadmap is provided below to indicate a sequence of events:

- Mobilise CSV to the Geographe field;
- Using a work class remote observation vehicle (ROV), perform as-found seabed survey, water jetting of lay route & cleaning of marine growth off existing infrastructure (connection points may require acid wash to remove calcareous growth);
- Confirm subsea isolations are in place (perform ROV valve operations to achieve subsea isolations if required);
- Remove and recover the Geographe-3 rigid spool indicated on from the SMC manifold (filled with MEG);
- Clean Geographe-3 rigid spool of marine growth prior to recovery to deck;
- Recover Geographe-3 spool to deck subject and conduct NORMs identification and management;
- Remove and recover SMC Vertical Connection System (VCS) pressure cap (future connection) and perform upward facing hub seal cleaning as required;
- Remove and recover Geographe-4 & Geographe-5 XT VCS pressure caps and perform upward facing hub cleaning as required;
- Insert chemical preservation dissolvable sticks into upward facing VCS hub and install VCS pressure cap onto Geographe-3 XT;
- Remove and recover the two existing EFLs between Geographe-2 XT and the SDU;
- Perform EHFL pre-deployment testing;
- Perform rigid spool pre-deployment flushing and nitrogen purging on the vessel deck prior to over-boarding;
- Install seven EFLs, including on-bottom stabilisation using grout bags as required;
- Install two HFLs between the XTs and the SDU, including on-bottom stabilisation using grout bags as required;
- Install two rigid spools between the SMC manifold and the Geographe-4 XT and Geographe-5 XT;
- Perform pre-commissioning (leak testing);
- Provide cold commissioning support;
- Perform SCM change-out & electrical fault finding (if required);
- Perform as-left ROV surveys; and
- Demobilise from field.

3.5.1 Installation of Production Spools

The two production spools connecting the new Geographe XTs with the SMCs will be 219 mm OD in diameter and constructed of duplex stainless steel. The spool lengths will be approximately 24 m each.

Drilling debris is expected to be within 5 m diameter around the XT. However, this is not expected to obstruct the rigid spool. An ROV will be used to inspect and, if required, clear drilling debris by water jetting along the intended rigid spool lay route prior to installation. The underside of the rigid spool will have a minimum clearance of 500 mm from the seabed. Each spool will be supported by grout bags positioned to meet the requirements of the spool design.

Each spool will be installed separately using a heave compensated subsea rated crane on the CSV. Each spool piece will be monitored and guided into place by two work class ROVs. Once the ROVs confirm the spool piece is landed in position, an ROV will disconnect the spool from the crane. An ROV will make up each end fitting flange on a spool via the ROV mechanical connection system.

The tie in and pre-commissioning (leak testing) of the new production spools to the new Geographe-4 and Geographe-5 wells will be carried out while the gas reservoir is isolated. The XT control systems and electrical and hydraulic umbilicals may be connected to enable monitoring of instruments. However, all remotely operated isolation barriers will be mechanically isolated to prevent inadvertent operation of valves. The multiple barriers in place to prevent release of well fluids to sea, including the Surface Controlled Subsurface Safety Valve (SCSSV), which is installed in the well, and the wellhead valves, will have been tested during well completion. XT and SMC manifold isolations will be subject to further verification prior to commencement of the tie in of the spools. This will be through observation of the pressure transmitters in the system and checks carried out by ROV to confirm the integrity of the well and manifold isolations prior to the tie in of the spools.

On opening the blind flanges on the XTs for tie in of the spools, there may be some release of residual brine/seawater. Discharge of residual hydrocarbons is not expected because existing manifold tie-in points have proven valve isolation barriers upstream (XT) and downstream (SMC Manifold) of the tie-in spool.

Following installation of the spools, the ROV will be used to conduct an as-built survey of the flange connections, and an as-built survey of the spool pieces and Geographe subsea infrastructure in the surrounding area. Once installed, each spool (combined with grout bags) is expected to cover 25 m^2 of seabed.

3.5.2 Electrical and Hydraulic Controls

The seven EFLs to be installed are 30 mm OD, between 10 to 100 m long, oil-filled moulded electrical cables and rated to 150 m water depths. EFLs will be secured in a deployment frame and subsequently lowered to the seabed using the crane on the CSV. The two HFLs to be installed are thermoplastic hose bundles 160 mm OD and 100 m long. The HFLs will be lowered to the seabed in deployment frames, landed on the target area on the seabed and subsequently installed and connected using the work class ROV. The EFLs and HFLs will be stabilised at 3-5 m intervals along their length with 25 kg grout bags. The installation and stabilisation process for the EFLs and HFLs is expected to take two days.

3.6 Commissioning Program

3.6.1 Production Spools Leak Testing

The rigid spools will be deployed with open ends and part filled with inhibited and dyed potable water or MEG (a low toxicity fluid). Prior to landout on the subsea hubs, chemical inhibitor and dye sticks will be inserted into the structure hubs to protect against ingress of seawater and to allow for visual indication during leak testing operations.

Once the spools have been landed, the mechanical vertical connector clamps will be closed and torqued to complete the connection of the spool to the SCM structure and XT piping systems. A backseal test will be performed on each of the spool connectors as an initial confirmation of the integrity of the seal, and this will be followed by a leak test of the spool performed via an ROV hot stab port. The boundaries of the test will be closed valves on the XT and structure, upstream and downstream of the spool. Requirements with regard to the leak test operations are specified in ASME, Gas Transmission and Distribution Piping Systems, ASME B31.8 ISO13628-1 Design and Operation of Subsea Production Systems.

The leak test involves pressurising the line and maintaining a specified test pressure (as defined in the design code). The pressure in the system is then monitored over the design code stipulated time period, and any decay in pressure is evaluated against the code-stipulated criteria to evaluate whether there is any potential leak. The ROV will be used to conduct visual observations of the spool connections (flanges) during the test period to identify any potential leak sources. The initial flooding of the spools during installation, and the pressurisation of the spools at the commencement of the leak testing, may result in the discharge of approximately 4 m^3 of treated seawater at the seabed.

3.6.2 Production Spools Fluids Displacement

Either prior to or post-leak test, the spools will be flushed with MEG in order to give displacement of the internal fluids. This operation will reduce the potential for hydrate formation within the spool during commissioning/ production start-up. The spool contents may be displaced to the environment via a hot stab port. The volume of flush would be approximately 2 x spool volume (or 4 m^3 per spool), resulting in a total discharge of 8 m^3 of inhibited water and MEG.

3.6.3 Electrical and Hydraulic Controls

Once the HFL is connected, it will be function tested by functioning the valve at system operating pressure. During this test, there is a low possibility that up to 500 L of Macdermid Oceanic 443 hydraulic fluid may be released.

Once the EFL is connected, it will be tested by instrument interrogation (no fluids are used in the EFL).

3.7 Construction Vessel

A purpose-built CSV has yet to be contracted. A support vessel will not be required for this activity.

The CSV is likely to be about 110 m in length and 20 m wide, with a capacity to carry up to 110 people. The CSV is likely to be similar to the MV *Seven Eagle* (Photo 3.1) that worked in eastern Bass Strait in 2018 and the MV *Sapura Constructor* that was used during the Otway Phase 3 development (Photo 3.2).

The CSV will feature a main crane and work class ROVs. The CSV is typically classified as a Class II dynamic positioning (DP) vessel, meaning it can remain on location without the need for anchoring.

Photo 3.1. The MV *Seven Eagle* offshore construction vessel

Photo 3.2. The MV *Sapura Constructor* offshore construction vessel

The CSV will not refuel at sea; enough fuel will be taken on at port (e.g., Port of Portland) for the duration of the activity. This means there is no potential for a refuelling spill in the activity area. The deep waters of the activity area and absence of emergent seabed features means there is no risk of the CSV colliding with submerged features that result in a hull breach and a fuel spill.

3.7.1 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.

The CSV will generate emissions and discharges just as all commercial vessels do. The CSV will be required to meet pollution prevention requirements under the MARPOL Convention, as enacted by the *Navigation Act* 2012 (Cth) (see Table 2.1). Table 3.4 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.

Beach will have a Client Representative onboard to provide quality assurance of the installation process and assist with implementation of the EP commitments.

Table 3.4. Key vessel environmental certifications

Certificate	Complies with
IOPP	MARPOL Annex I, enacted under Marine Orders Part 91 (Marine Pollution Prevention – Oil)
SMPEP	MARPOL Annex I, enacted under AMSA Marine Orders Part 91 (Marine Pollution Prevention – Oil)
IPP	MARPOL Annex II, enacted under AMSA Marine Orders Part 93 (Marine Pollution Prevention – Noxious Liquid Substances)
ISPP	MARPOL Annex IV, enacted under AMSA Marine Orders Part 96 (Marine Pollution Prevention – Sewage)
GMP	MARPOL Annex V, enacted under AMSA Marine Orders Part 95 (Marine Pollution Prevention – Garbage)
IAPP, EIAPP, IEE, 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)

3.7.2 Regulatory Jurisdiction

The vessel comes under the regulatory jurisdiction of AMSA under the *Navigation Act* 2012 (Cth) 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).

3.7.3 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 (published fortnightly). 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).

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.

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.

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 construction vessel would not be necessary.

3.8 Activity Summary

Table 3.5 summarises the key activity parameters.

Table 3.5. Summary of the key activity parameters

Parameter	Details
Installation window	Beginning of July to end of October 2021
Duration of activity	Up to 30 days
Water depth	85 m
Permit area	VIC/L23
Construction vessel	
Contractor	Unknown at time of EP submission
Vessel	CSV (not currently contracted)
Refuelling	In port only

4. Stakeholder Consultation

4.1 Otway Offshore Project

This activity is part of Beach's Otway Phase 4 Development. Activities associated with this development include:

- Seabed assessments to determine the suitability of the seabed for drilling and infrastructure;
- Inspections and modifications to existing seabed infrastructure to prepare for the new wells;
- Drilling of offshore exploration, appraisal and production wells;
- Tie-ins to connect new production wells to the existing platform and pipeline;
- Abandoning some wells in the Geographe and Thylacine fields; and
- Establishing Petroleum Safety Zones (PSZ) for new wells and infrastructure.

The activities assessed under this EP are focussed on the tie-ins to connect the new Geographe-4 and Geographe-5 production wells to the existing pipeline and are part of the broader Otway Phase 4 Development scope. As such, stakeholder consultation for this activity has been captured in the broader consultation efforts for the Otway Phase 4 Development. 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.

Public notices regarding activity updates are issued by email to stakeholders and are made available more broadly through the Beach website (Otway Basin operations page) at: https://www.beachenergy.com.au/vic-otway-basin/. The latest project update flyer is included in Appendix 3, noting that earlier project updates that specifically mention the subsea installation works are included in Appendix 4.

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

- Artisan-1 Exploration Well Drilling EP (CDN/ID S4810AH717904) (NOPSEMA In-force EP 53157);
- Otway Development Drilling and Well Abandonment (CDN/ID S4100AH717905) (NOPSEMA RMS ID 4963); and
- T/30P Geophysical and Geotechnical Seabed Survey (S4200AH718461) (NOPSEMA In-force EP 5197).

A complete copy of original communications to and from all stakeholders is provided in Appendix 4.

5. Existing Environment

In accordance with OPGGS(E) Regulation 13(2), the EMBA by the activity is described in this section, together with its values and sensitivities. While each hazard associated with the activity has its own unique EMBA, the largest one has been chosen (the 'hydrocarbon spill EMBA') for this chapter so as to describe all possible values and sensitivities, which is a marine diesel oil (MDO) spill from within the activity area.

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

> *The extent of low level hydrocarbon exposure to the sea surface (0.5 g/m^2), entrained in the water column (10 ppb) and dissolved in the water column (6 ppb) as a result of a release of 300 m^3 of MDO (over 6 hours) from the CSV during summer and winter metocean conditions.*

This spill EMBA has been established through hydrocarbon spill modelling that was completed for the Artisan-1 exploration well (RPS, 2019), which is located approximately 25 km northwest of the activity area. The results of this existing spill modelling are considered applicable and representative of the credible spill scenarios associated with this activity (MDO spill) given their close proximity and the similarity of credible spill scenario (MDO spill).

The spill EMBA is highly conservative and represents the results of 200 simulations of the spill scenario and does not represent the actual area that may be affected by a single worst-case spill event. The EMBA is based on the in-water exposure of thresholds as defined in Table 7.21. Because of this, the EMBA is very large and covers areas that are unlikely to be affected by any single spill event. The modelling was conducted under winter (April to September) and summer (October to March) metocean and weather conditions. Figure 5.1 and Figure 5.2 present the winter and summer results of the modelling, respectively. From there on, the results are combined and displayed as an EMBA representative of both seasons (Figure 5.3).

The maps presented in this chapter illustrate the following phases of MDO fate under the scenario:

- Sea surface – floating hydrocarbons at the sea surface;
- Entrained – hydrocarbon droplets suspended in the water column;
- Dissolved – hydrocarbons dissolved in the water column; and
- Shoreline – hydrocarbons accumulated on the shoreline.

Where appropriate, descriptions of the Otway shelf and Bass Strait environment (beyond the spill EMBA) are provided for context. The 'environment' is defined in the OPGGS(E) regulations, and adopted here, as:

- Ecosystems and their constituent parts, including people and communities;
- Natural and physical resources;
- The qualities and characteristics of locations, places and areas;
- The heritage value of places; and
- The social, economic and cultural features of these matters.

The key sources of information used to describe the EMBA include the:

- EPBC Act Protected Matters Search Tool (PMST) database (DAWE, 2020a), conducted for the activity area and EMBA on 12th January 2021 (Appendix 5);
- Otway Basin Environmental Survey (Ramboll, 2020) (Appendix 6);

- Species Profile and Threats (SPRAT) Database (DAWE, 2020b);
- South-east Marine Region Profile (DoE, 2015a);
- Marine Natural Areas Values Study Vol 2: Marine Protected Areas of the Flinders and Twofold Shelf Bioregions (Barton *et al*., 2012);
- National Conservation Values Atlas (NCVA) (DAWE, 2020c); and
- Victorian Oil Spill Response Atlas (OSRA) (DEDJTR, 2017).

The relevant values and sensitivities considered in this section are inclusive of but not limited to the matters protected under Part 3 of the EPBC Act.

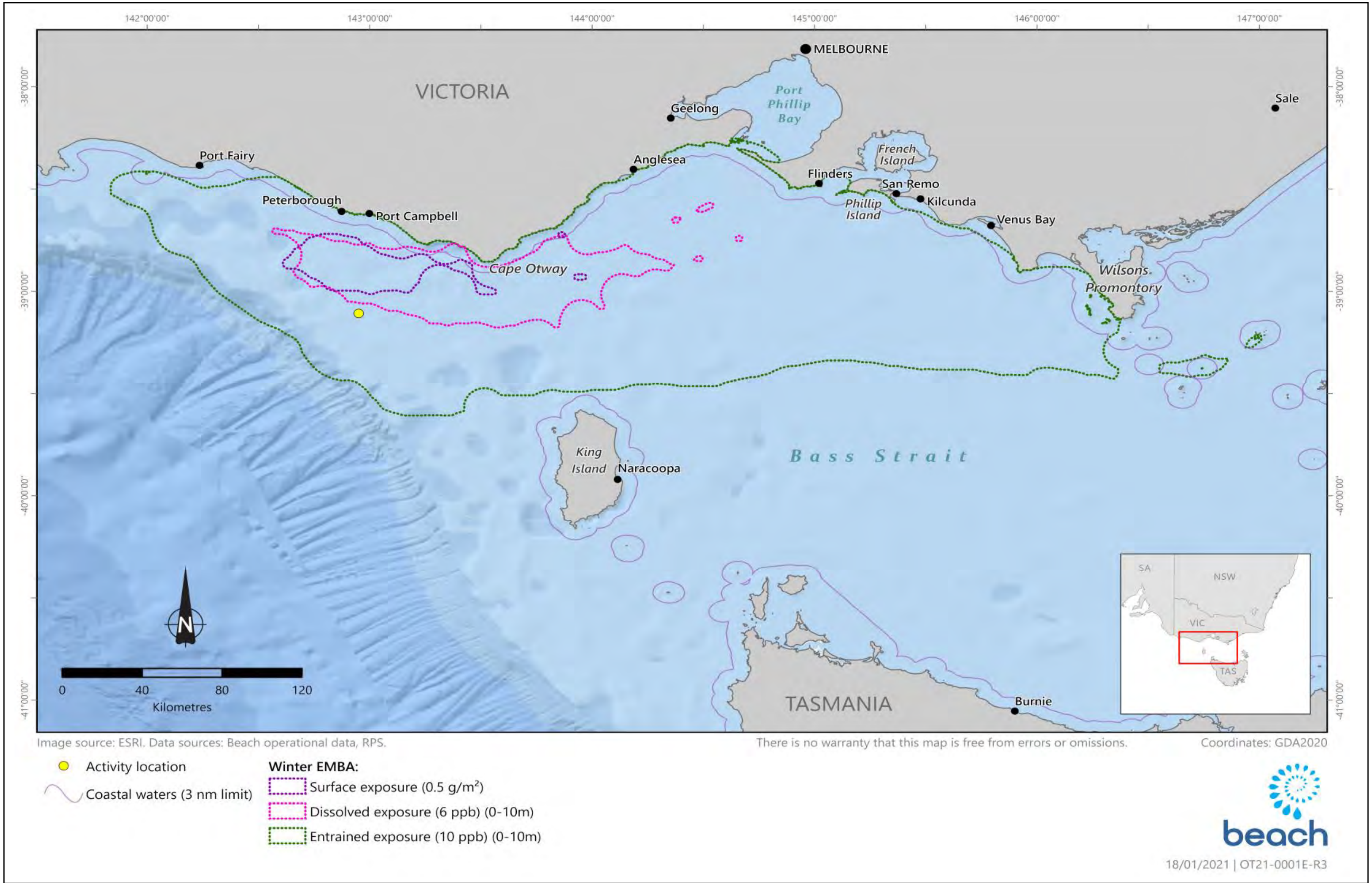


Figure 5.1. The Geographe subsea installations EMBA (winter conditions)

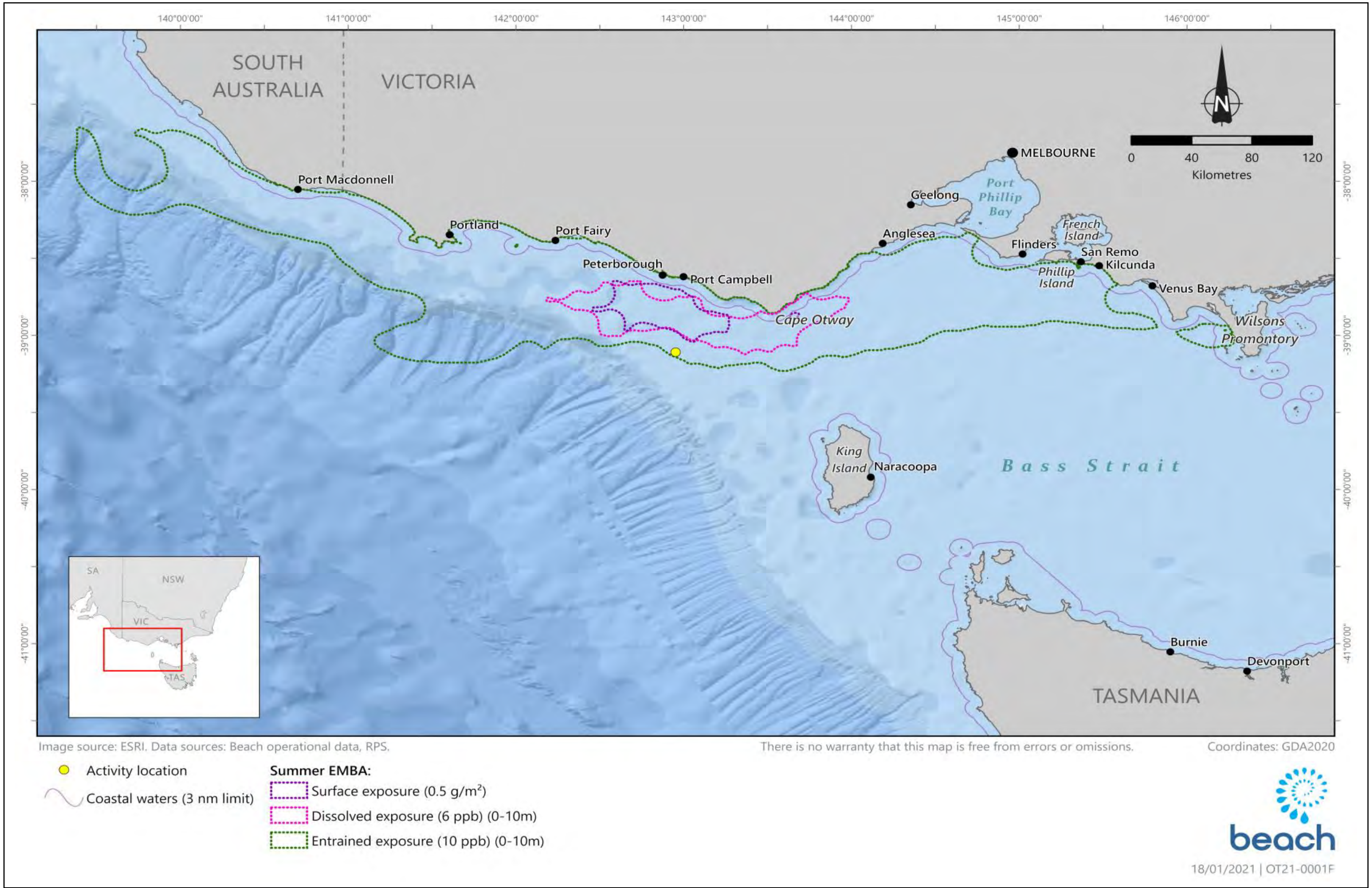


Figure 5.2. The Geographe subsea installations EMBA (summer conditions)

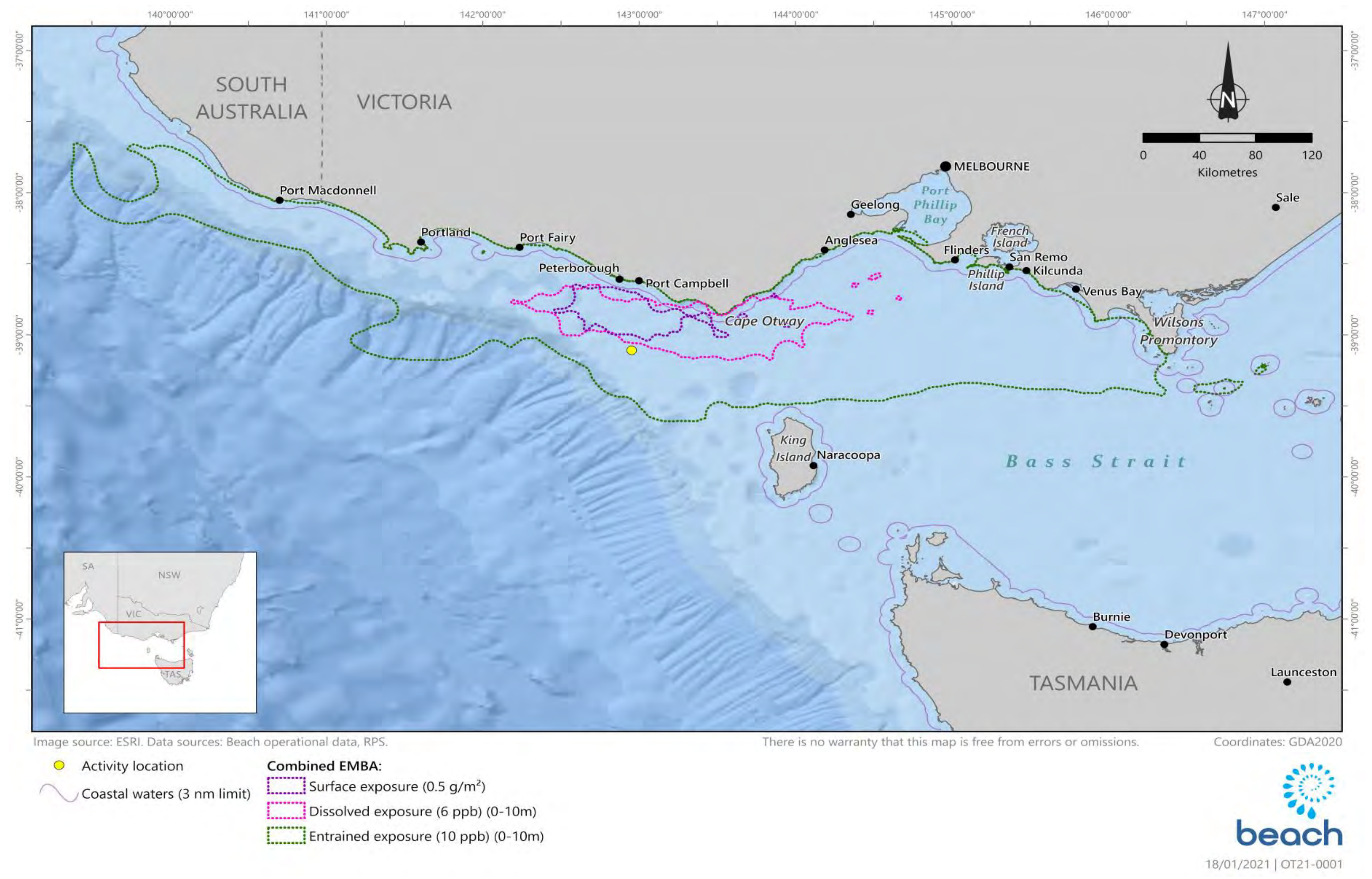


Figure 5.3. The Geographe subsea installations EMBA (combined conditions)

Table 5.1 summarises the presence and absence of receptors and sensitivities within the activity area and the EMBA.

Table 5.1. Presence of receptors within the activity area and the EMBA

Receptor	Activity area	EMBA
Physical		
Soft sediment seabed		
Sandy shores		
Rocky reef		
Rocky shores		
Sponge gardens		
Seagrass communities		
Conservation Values		
Australian Marine Parks (AMPs)		
World Heritage-listed properties		
National Heritage-listed properties		
Threatened Ecological Communities (TECs)		
Key Ecological Features (KEFs)		
Nationally important wetlands		
Victorian marine protected areas		
Tasmanian marine protected area		
Onshore protected areas		
Biological environment		
Plankton		
Benthic species		
Abalone		
Scallops		
Rock lobsters		
Fish		
BIA, great white shark	Distribution	
Cetaceans		
BIA, pygmy blue whale	Foraging	
BIA, southern right whale	Core range	
BIA, humpback whale		
Pinnipeds	Foraging only	Haul out and breeding sites
Turtles	Unlikely	Vagrant only, no nesting grounds
Seabirds	Foraging, flyovers, BIA for many species	
Shorebirds		
Marine pests	Possible	

Receptor	Activity area	EMBA
Cultural heritage values		
Shipwrecks		
Indigenous heritage		
Socio-economic environment		
Native title		
Tourism		
Recreational fishing		
Commercial fishing		

Green cells = presence of receptor, red cells = absence of receptor.

5.1 Regional Environmental Setting

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

There are significant variations in seafloor features throughout the SEMR including seamounts, canyons, escarpments, soft sediments and rocky reefs, which support high levels of biodiversity and species endemism (DoE 2015a). Compared to other marine areas, the SEMR is relatively low in nutrients and primary production; however localised areas of high productivity are known to occur. There are areas of continental shelf, which includes Bass Strait and the 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 Upwelling is an area of seasonally higher primary productivity that attracts baleen whales and other species (including EPBC-listed species) that feed on the plankton swarms (krill) (DoE 2015a).

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).

The following IMCRA mesoscale zones are intersected by the EMBA:

- Otway;
- Central Bass Strait;
- Central Victoria;
- Victorian Embayments; and
- Flinders

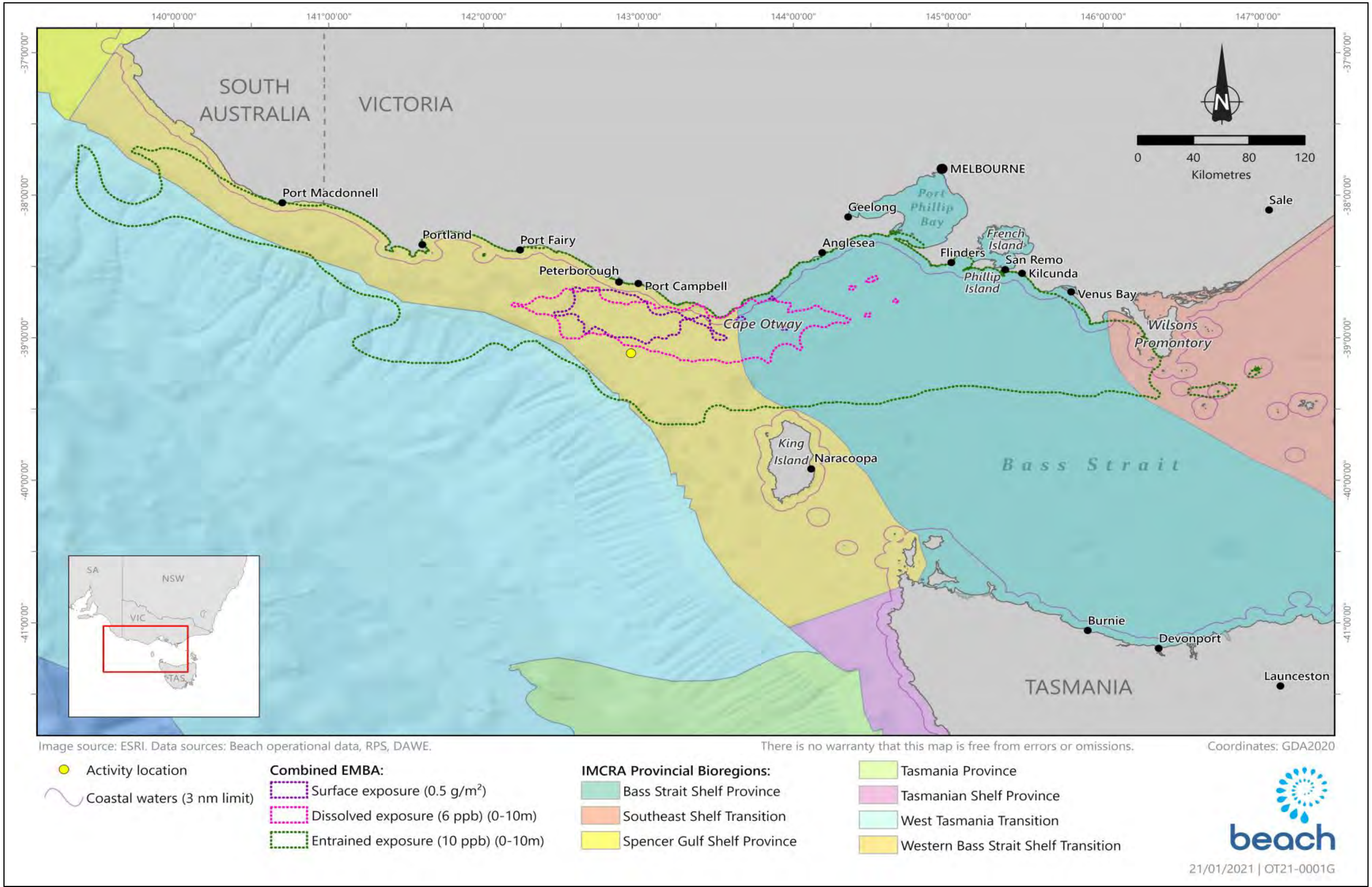


Figure 5.4. IMCRA provincial bioregions

5.2 Physical Environment

5.2.1 Climate and Meteorology

The activity area and EMBA is typical of a cool temperate region with cold, wet winters and warm dry summers. The regional climate is dominated by subtropical 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 southwest to northeast across the region, producing strong winds from the west, northwest and southwest.

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.

5.2.2 Temperature and Rainfall

Average air temperatures recorded at Warrnambool airport (88 km northwest of the activity area, but the closest point for a Bureau of Meteorology [BoM] weather station) for 1999-2020 range from 18.2°C to 19.6°C (BoM, 2020).

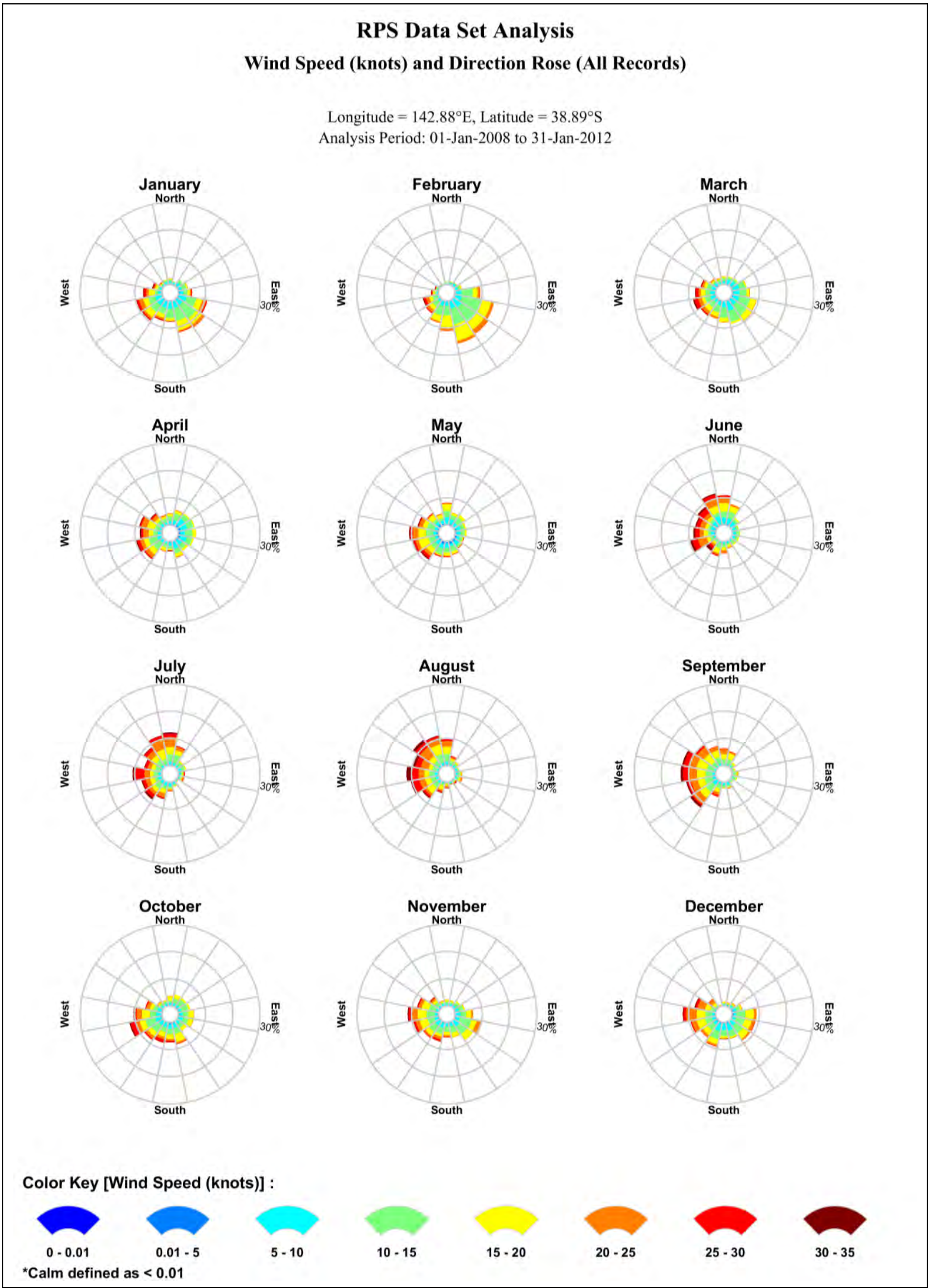
Mean annual rainfall for the period 1999-2020 is 726 mm, with the highest rainfall totals falling in June, July and August (BoM, 2020).

5.2.3 Winds

The Otway Shelf 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.

RPS (2019) acquired high-resolution wind data from 2008 to 2012 (inclusive) across their modelling domain from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR). Figure 5.5 illustrates the monthly wind rose distributions from 2008 to 2012 (inclusive), which clearly indicates that winds from the southwest dominate this region for most of the year



Source: RPS (2019).

Figure 5.5. Modelled monthly wind rose distributions

5.3 Oceanography

5.3.1 Tides and Currents

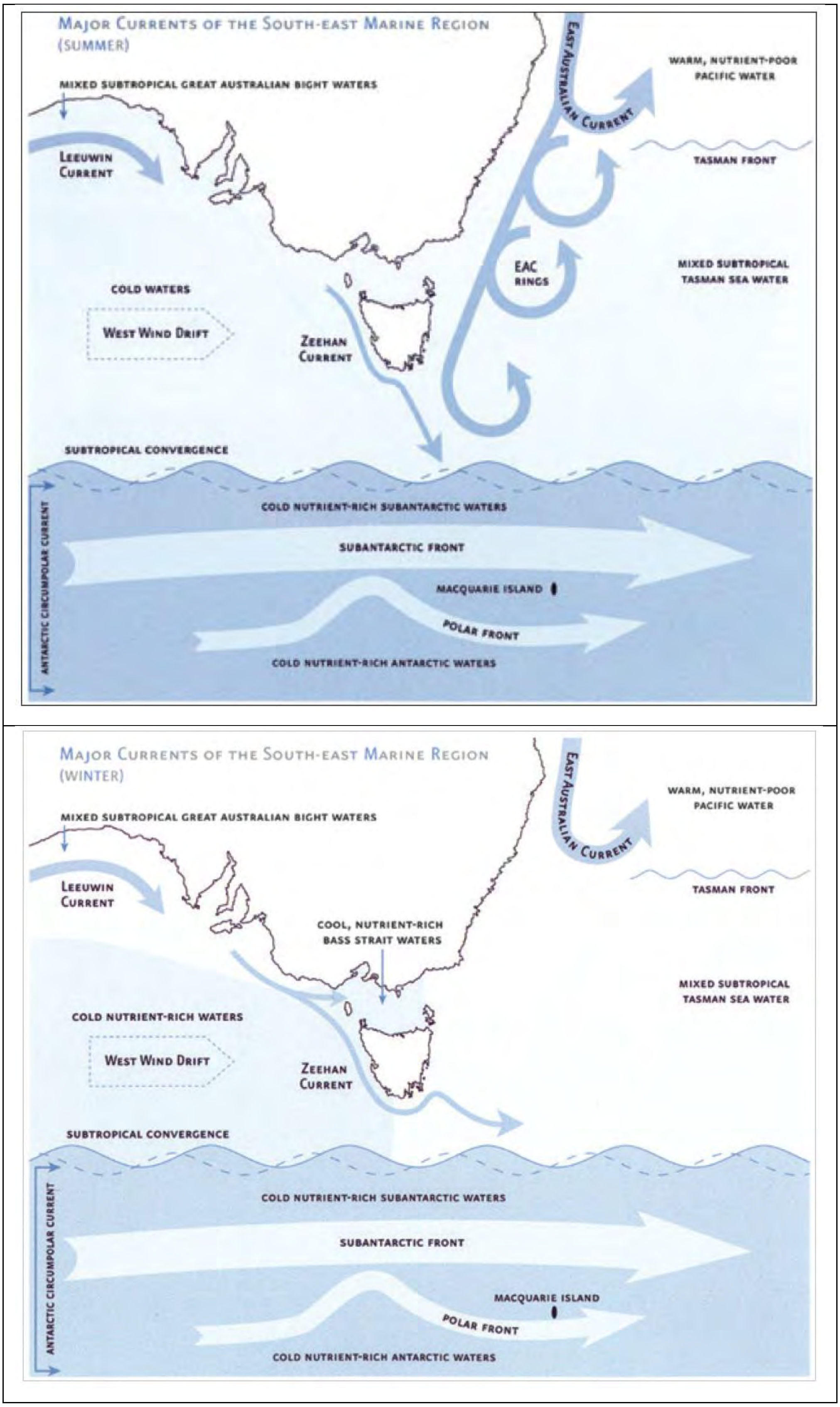
Tides are semi-diurnal with some diurnal inequalities (Jones and Padman, 1983), generating tidal currents along a northeast/southwest axis, with speeds generally ranging from 0.1 to 2.5 m/s (Fandry, 1983). The maximum range of spring tides in western Bass Strait is approximately 1.2 m. Sea level variation in the area can arise from storm surges and wave set up (Santos, 2004). Bass Strait has a reputation for strong tidal currents, which are primarily driven by tides, winds and density-driven flows. The tides of central Bass Strait are semi-diurnal with the dominant large-scale water movements due to the astronomical tide (Jones, 1980).

The tidal waves enter Bass Strait from the east and west almost simultaneously and as a result in the centre of the strait there is an area with small tidal currents where the two waves meet. The magnitude of the tidal currents then increases as the distance from the central strait increases with relatively strong tidal currents at either end. The times and magnitudes of the tide within Bass Strait are relatively uniform and predictable. However, the effects of meteorological phenomena may be significant, causing variations in level and also changing the phasing or timing of the tide (Sandery and Kampf, 2005).

The region is oceanographically complex, with subtropical influences from the north and sub-polar influences from the south (DoE, 2015a). There is a slow easterly flow of waters in Bass Strait and a large anti-clockwise circulation (DoE, 2015a). Three key water currents influence Bass Strait:

1. The **Leeuwin Current** transports warm, sub-tropical water southward along the Western Australian (WA) coast and then eastward into the Great Australian Bight (GAB), where it mixes with the cool waters from the Zeehan Current running along Tasmania's west coast (DoE, 2015a). The Leeuwin and Zeehan currents are stronger in winter than in summer, with the latter flowing into Bass Strait during winter.
2. The **East Australian Current** (EAC) is up to 500 m deep and 100 km wide, flows southwards adjacent to the coast of NSW and eastern Victoria, and carries warm equatorial waters (DoE, 2015a). The EAC is strongest in summer when it can flow at a speed of up to 5 knots, but flows more slowly (2-3 knots) in winter where it remains at higher latitudes.
3. The **Bass Strait Cascade** occurs during winter along the shelf break, which brings nutrient-rich waters to the surface as a result of the eastward flushing of the shallow waters of the strait over the continental shelf mixing with cooler, deeper nutrient-rich water (DoE, 2015a).

Figure 5.6 illustrates the major ocean currents in south-eastern Australian waters during summer and winter.



Source: DoE (2015a).

Figure 5.6. Major ocean currents in south-eastern Australian waters during summer (top) and winter (bottom)

5.3.2 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; and
- 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.

5.3.3 Water 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 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.

5.3.4 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, 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 upwelling) around the continental shelf margin. 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, 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 Fairy 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), 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, located 24 km and 10 km from the activity area, respectively. Due to poor weather conditions sampling had to be reduced. It was decided that the Artisan field would be representative of the water quality closer to shore and of the LaBella and Hercules fields, while the Thylacine field which is further offshore would represent the Geographe field.

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

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

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. Total suspended solids (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 TRHs were detected in the one of the Thylacine water samples 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. The Thylacine survey area is considered representative of the water quality at the Geographe gas field. As such, the water quality within the activity area and spill EMBA is likely to 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.

5.3.5 **Sediment Quality**

The environmental survey undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020) collected sediment samples at the Artisan and Thylacine locations using a Double Van Veen grab sampler. Due to poor weather conditions sampling had to be reduced. Three replicate sediment samples were to be collected at each of the gas 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 oxidation-reduction potential (ORP) or redox 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 (ISQG) low trigger value of 80 mg/kg from the recommended sediment quality guidelines set out in ANZECC (2000). The concentration of Cr was slightly higher in the samples from Artisan than those from Thylacine. Zn was detected in two of the six samples (one sample from each field) and was well below the ISQC-Low trigger value.

BTEXs, PAHs, PCBs and TRHs were either below the level of reporting 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 EMBA will be typical of the offshore marine environment of the Otway Basin.

5.3.6 **Air Quality**

Historical air quality data for the region is available from the 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 goals and standards being met for carbon monoxide (CO), nitrogen dioxide (NO_2), Ozone (O_3) and sulfur 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 and activity area. The Cape Grim Baseline Air Pollution Station data is likely a more reliable point of reference for air quality in the 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 chlorofluorocarbons (CFCs) and halons are in decline. Increases have been attributed to anthropogenic causes, for example, fossil fuel consumption and agricultural practices (CSIRO, 2017).

5.3.7 Ambient Ocean 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) recorded underwater sound south of Portland, Victoria (38° 32.5' S, 115° 0.1' E). Prominent sound sources identified in recordings include blue and fin whales at frequencies below 100 Hz, ship noise at 20 to 200 Hz and fish at 1 to 2 kHz (Erbe *et al*., 2016). In the broader region, primary contributors to background sound levels were wind, rain and currents and waves associated sound at low frequencies under 2 kHz (Przeslawski *et al*., 2016). Biological sound sources including dolphin vocalisations were also recorded (Przeslawski *et al*., 2016).

Ambient sound levels in the Otway Basin have been measured as part of impact assessment activities for the petroleum industry. Acoustic monitoring prior to the development of the Thylacine wells and platform, recorded broadband underwater sound of 93 to 97 dB re 1 µPa (Santos, 2004). An acoustic monitoring program was also undertaken during exploratory drilling of the Casino-3 well in the spill EMBA. A sound logger located 28.03 km from Casino-3 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 is 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).

Recent work using ocean sound recordings stations has also shown that sound from iceberg calving, shoaling and disintegration in Antarctic waters is a major contributor to the overall sound budget of the Southern Ocean. Annually tens of thousands of icebergs drift out from Antarctica into the open waters of the Southern Ocean, creating a ubiquitous natural source of low frequency sound as they calve, shoal and disintegrate (Matsumoto *et al*., 2014).

For example, Dziak et al (2013) measured the sounds from the iceberg A53a (~ 55 × 25 km) as it drifted out of the Weddell Sea and through Bransfield Strait during April–June 2007. Sound levels during disintegration of this iceberg were estimated to average ~ 220 dB re 1 µPa. Chapp et al (2005) acoustically located iceberg B15d (215 km^2) within the Indian Ocean in 2005 and estimated a maximum source level of 245 dB re 1mPa for its tremor signals, generated when the icebergs shoal or collide with other icebergs.

Matsumoto et al (2014) tracked the sound propagation of two large icebergs, B15a and C19a, which calved off the Ross Ice Shelf in the early 2000s and drifted eastward to the warmer South Pacific Ocean in late 2007. From 2008 to early 2009, the disintegration of B15a and C19a continuously projected loud, low-frequency sounds into the water column which propagated efficiently to lower latitudes, influencing the soundscape of the entire South Pacific basin. The icebergs' sounds were recorded at Juan Fernández Islands (34°S, 79°W) and by a deep-water hydrophone in the northern hemisphere (8°N, 110°W) approximately 10,000 km from the icebergs.

More broadly, Matsumoto et al (2014) concluded that seasonal variations in ocean noise, which are characterized by austral summer-highs and winter-lows, appear to be modulated by the annual cycle of Antarctic iceberg drift and subsequent disintegration. This seasonal pattern is observed in all three Oceans of the Southern Hemisphere. Spectrogram plotting shows that icebergs' sounds dominate the frequency range below 100 Hz (Matsumoto *et al*., 2014). Notably this frequency range encompasses the dominant frequencies at which baleen whales vocalize.

5.3.8 Seabed

<u>Otway Shelf and Bass Strait</u>

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 off Robe, SA, and eastward to 80 km off Warrnambool. The Otway shelf is comprised of Miocene limestone below a thin veneer of younger sediments. The bathymetry of the activity area and EMBA is presented in Figure 5.8.

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 5.7 and Table 5.2). The spill EMBA is within the five zones while the activity area situated in the middle shelf zone.

In the shallow shelf are exhumed limestone substrates that host dense encrusting mollusc, sponge, bryozoan and red algae assemblages. The middle shelf is a zone of swell-wave shoaling and production of mega-rippled bryozoan sands. The deep shelf is described as having accumulations of intensely bioturbated, fine, bio clastic sands. At the shelf edge and top of slope, nutrient-rich upwelling currents support extensive, aphotic bryozoan/sponge/coral communities. The upper slope sediments are a bioturbated mixture of periplatform bioclastic debris and pelleted foraminiferal/nanno-fossil mud. The lower slope is described as crosscut by gullies with low accumulation rates, and finally, at the base of the slope the sediments consist of shelf-derived, coarse-grain turbidites and pelagic ooze (Boreen *et al.*, 1993).

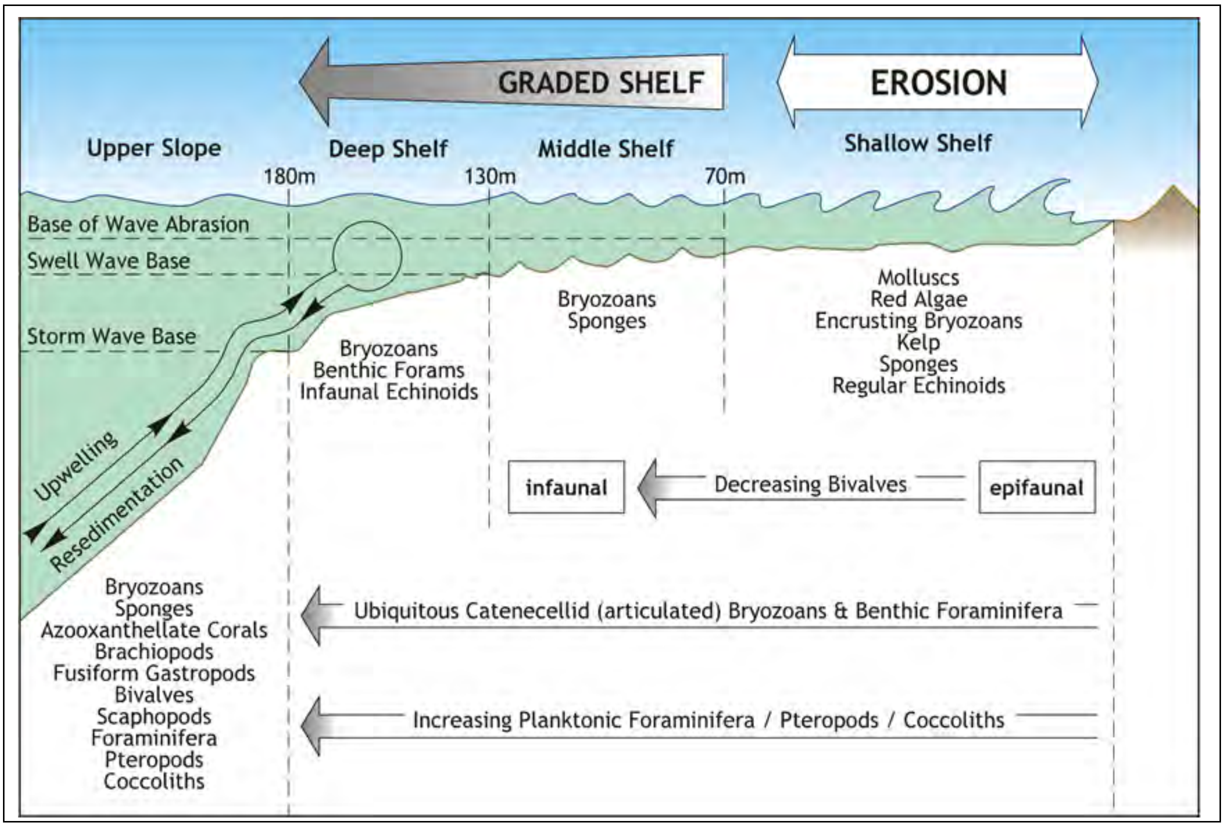


Figure 5.7. Model of the geomorphology of the Otway Shelf (Boreen *et al.*, 1993)

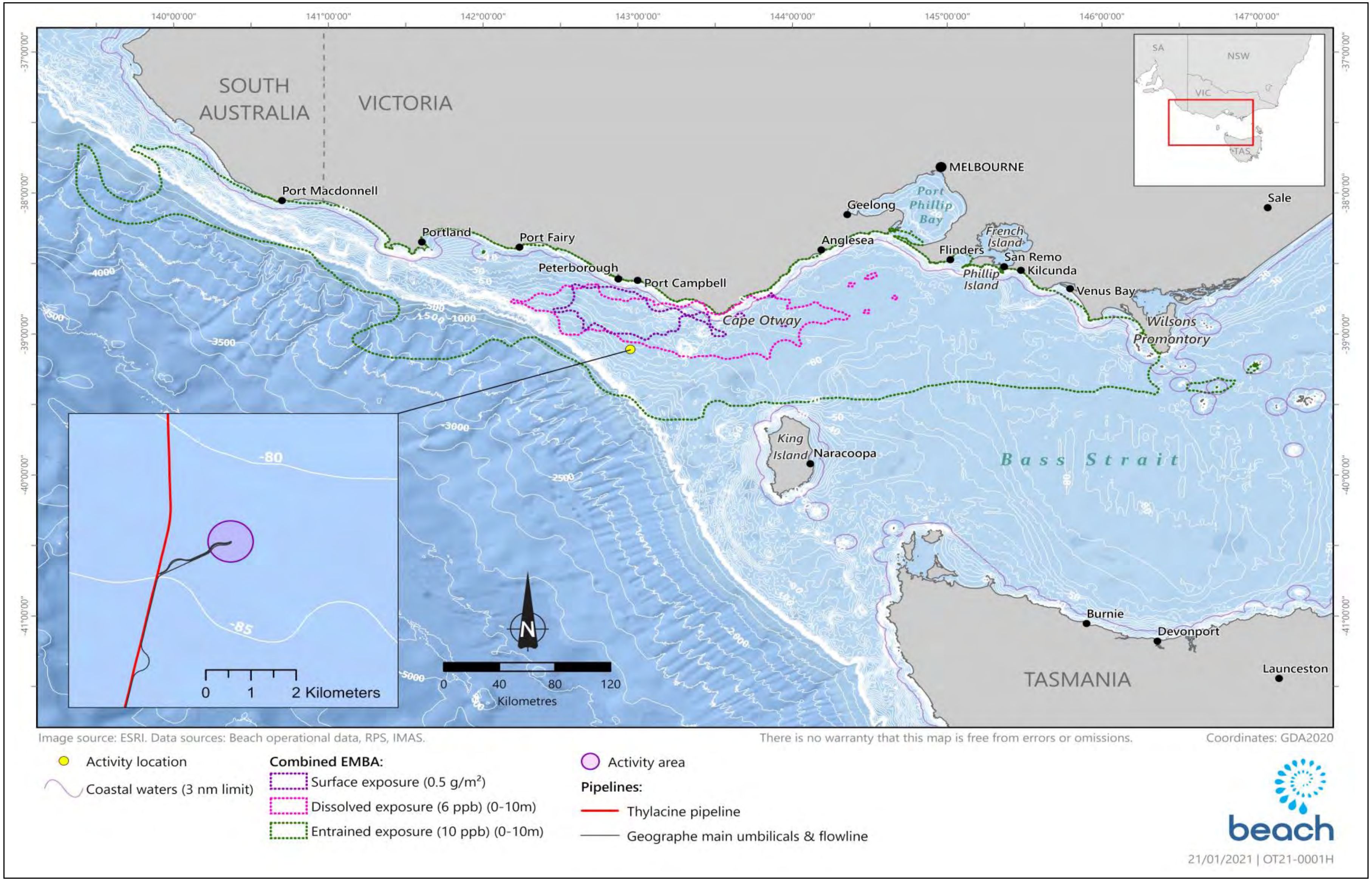


Figure 5.8. Bathymetry of the Otway Basin and the activity area

Table 5.2. Otway margin geomorphology (Boreen *et al.*, 1993)

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

A sampling survey of the surficial sediments, benthic invertebrates and demersal fishes of Bass Strait and the Otway Shelf 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 considered some of the most representative for this activity (Figure 5.9). Sediments were described in the field from a visual impression or according to the classification of Shepard (1954) (Table 5.3). 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.

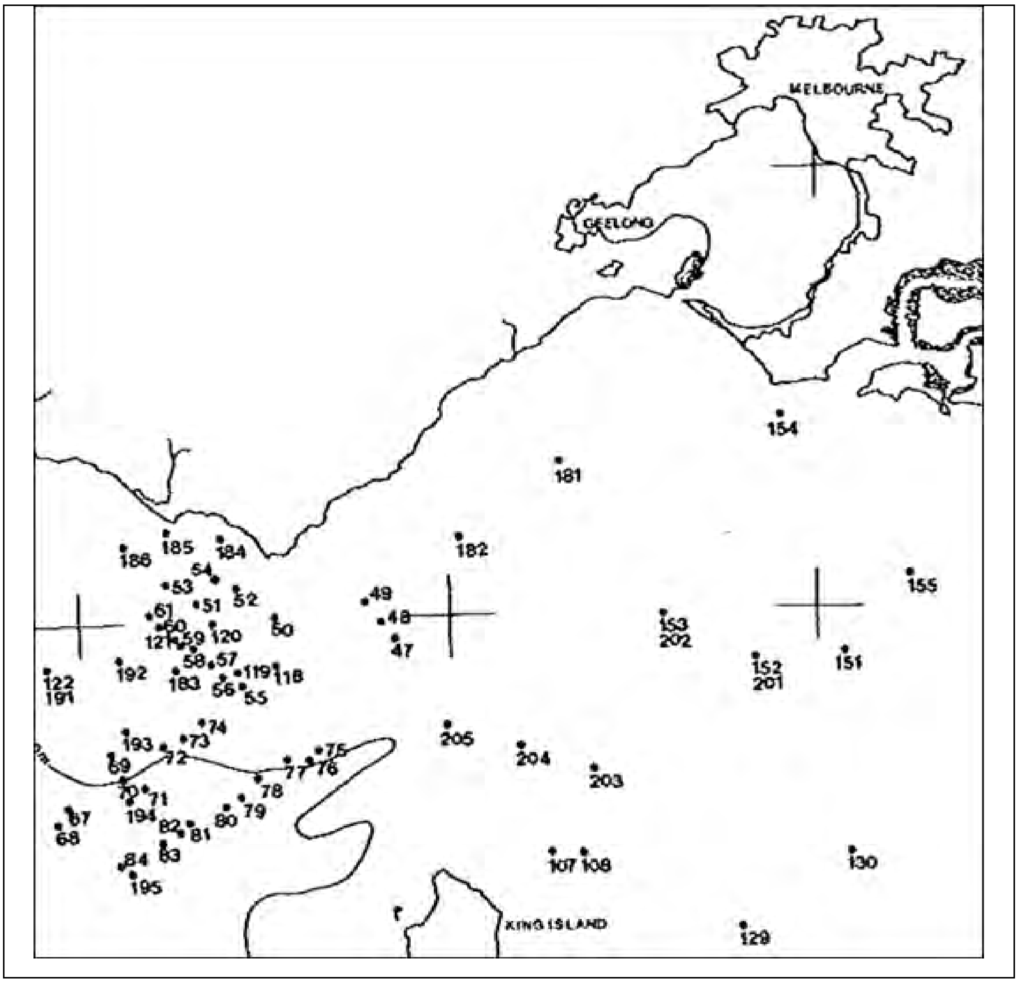


Figure 5.9. Sampling sites for the Bass Strait survey in the region of the spill EMBA (Wilson and Poore, 1987)

Table 5.3. Classification of surficial sediments sampled during the Bass Straight survey in the vicinity of the EMBA (Wilson and Poore, 1987)

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
51	67	Medium sand	ND
52	49	Coarse sand	72
53	67	Medium sand	45
54	70	Very coarse shelly sand	70
55	85	Coarse carbonate sand	93
56	77	Medium sand	ND
57	59	Coarse sand	97
58	47	Coarse sand	92
59	70	Coarse sand	89
60	79	Medium carbonate sand	100
61	68	Coarse sand	ND
118	95	Fine sand	96
119	92	Fine sand	99
120	84	Medium sand	90
121	84	Medium sand	ND
183	84	Coarse sand	99
186	69	Fine sand	ND
192	81	Medium sand	100

Otway seabed assessments and surveys undertaken in the activity area and 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 route options from the Otway Gas Project EIS (Woodside, 2003). These data have been supplemented by numerous benthic sampling events. 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 (Figure 5.10). The areas surveyed are located within the EMBA for this activity.

The Flaxman's Hill alignment (Figure 5.10) 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, 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 5.4 to Table 5.7.

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).

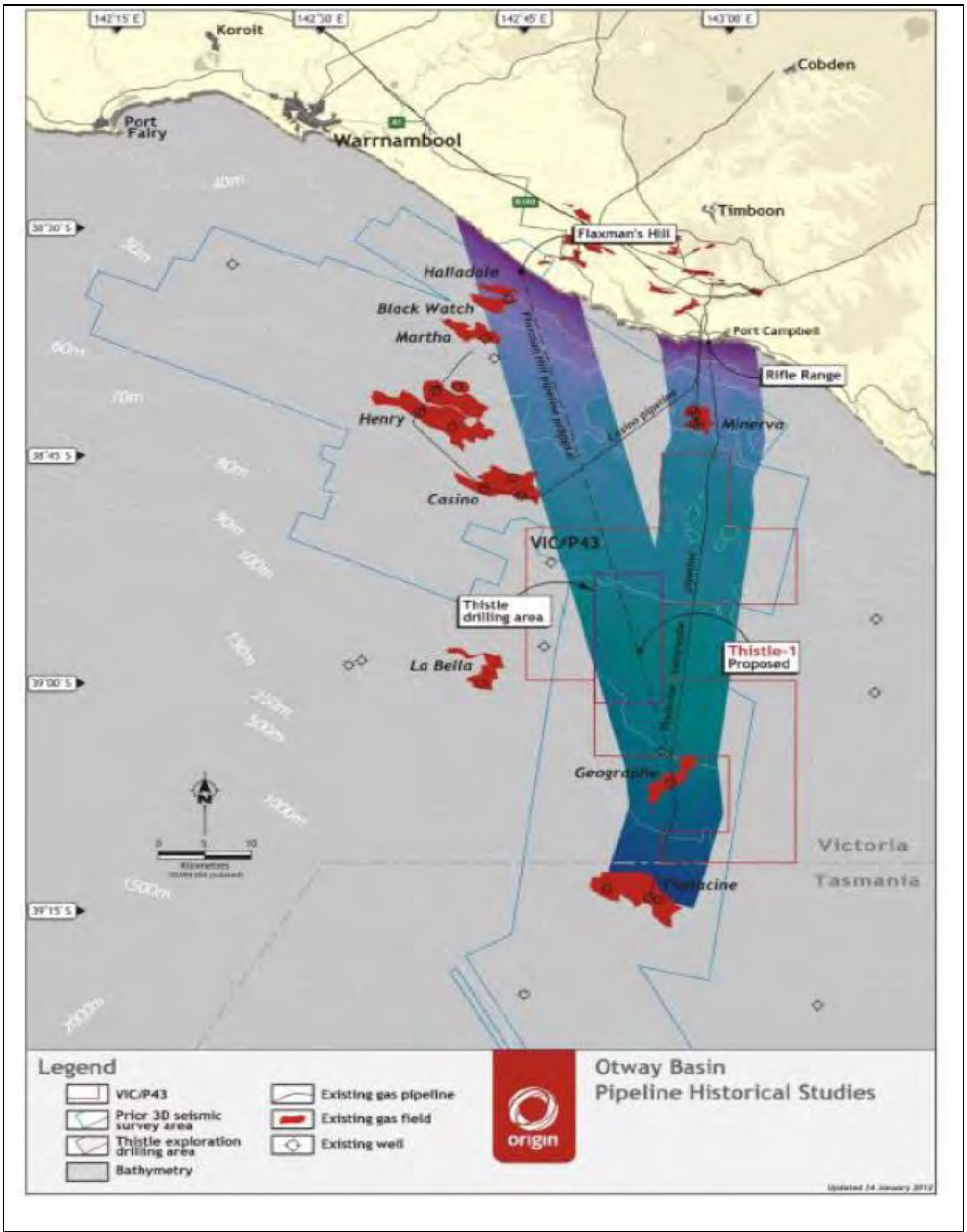


Figure 5.10. Otway Basin previous seabed survey locations

Table 5.4. Thylacine to Geographe seabed morphology and benthic assemblages (CEE, 2003)

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

Table 5.5. Geographe to Flaxman's Hill seabed morphology and benthic assemblages (CEE, 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 percentage 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, medium density sessile sponge dominated
68		Medium density, sessile: sponge, dominated
65		Diverse, med density sessile, sponge dominated
60		Medium density, sessile: sponge, dominated

Table 5.6. Geographe to Rifle Range seabed morphology and benthic assemblages (CEE, 2003)

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

Depth (m)	Seabed morphology	Benthic assemblage
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 5.7. 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 limestone reef to sand	High density, sessile sponge, macroalgae (Bull kelp common)

A video survey of the seabed at selected sites along proposed offshore pipeline routes for the Otway Gas Project was undertaken by BBG during 2003 (Figure 5.11). BBG (2003) found that the substrate in water depths between 82 and 66 m were predominantly low-profile limestone with an incomplete sand veneer that supported a low to medium density, sponge-dominated filter feeding community. Fish and other motile organisms were uncommon.

In shallower depths of between 63 and 30 m, the video surveys showed a rippled, sand or sand/pebble substrate with minor sponge dominated benthic communities. The epibenthic organisms were generally attached to outcropping or sub-outcropping limestone pavements. Only in waters shallower than approximately 20 m, was an area of significant, high profile reef and associated high density macroalgae dominated epibenthos encountered. Details of the seabed and benthic epifaunal assemblage are provided in Table 5.8. The site most relevant to the activity area is 2801.

Table 5.8. Seabed characteristics and epifaunal assemblage at video survey sites (BBG, 2003)

Site No.	Depth (m)	Seabed type	Benthic Assemblage
3097	99	Bare rippled sand; minor limestone outcrops	Low density sessile; small sponge dominated
3118	99	Low profile limestone reef with sand veneer; isolated areas of raised limestone	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 limestone; 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

Site No.	Depth (m)	Seabed type	Benthic Assemblage
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
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 5.11. Seabed sites assessed by video survey during 2003 (BBG, 2003)

Beach undertook a seabed site assessment for the Otway Gas development from November 2019 to January 2020 in water depths ranging from 70 to 104 m. The survey extent including the gas fields and infrastructure routes are shown in Figure 5.12.

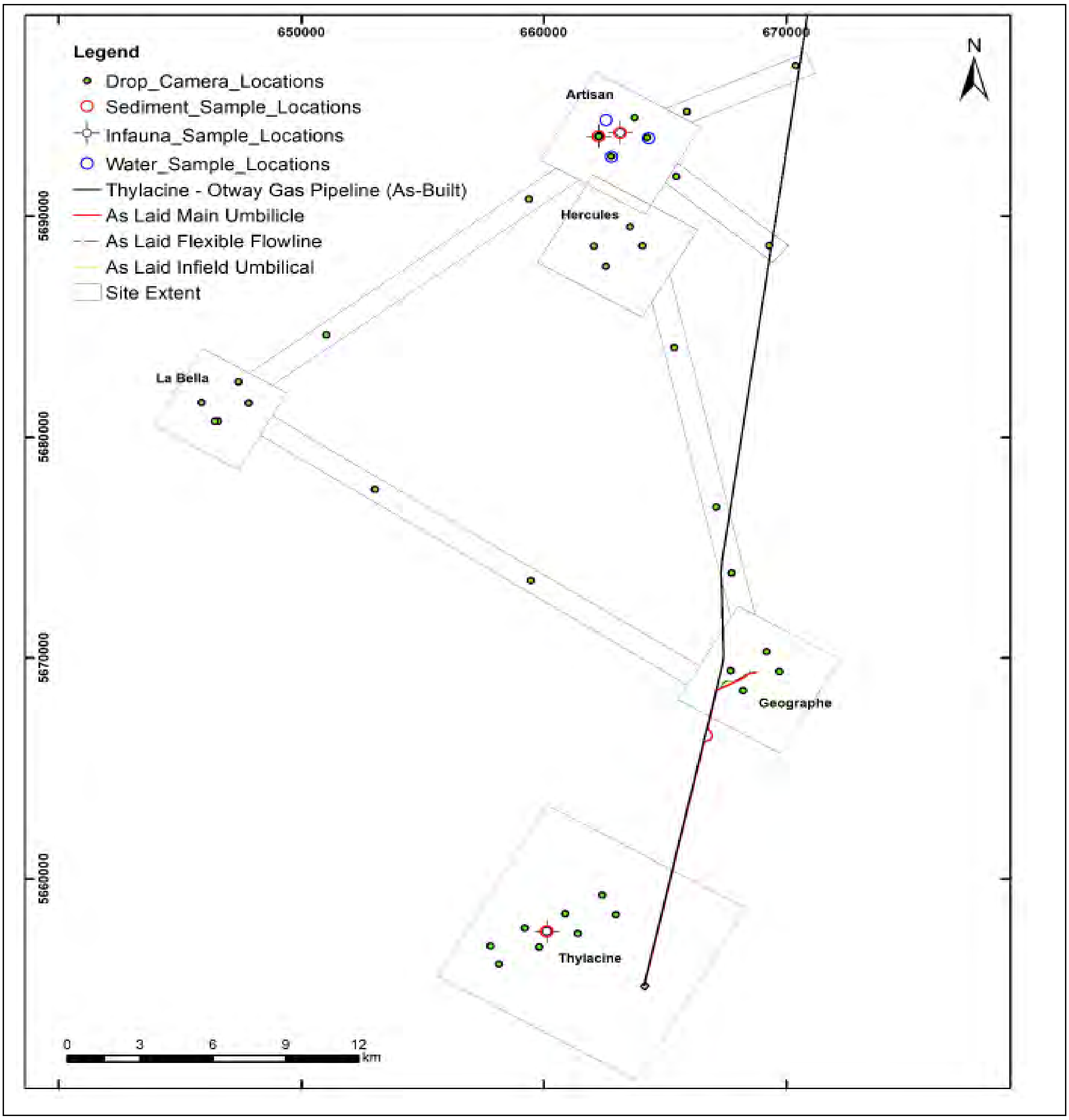


Figure 5.12. Location of the Otway Development seabed site assessment

The objective of the seabed site assessment was to determine suitable locations for anchoring and rig placement for drilling operations and the installation of infrastructure to connect new production wells to the existing platform or pipeline, including at the Geographe field. 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). As noted in Section 5.3.4, sampling undertaken at the Thylacine field is considered representative of the Geographe field.

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

The composition and percent coverage of epifauna was assessed from photographs of the seafloor taken at the Geographe location with a drop camera system (Ramboll, 2020). Percent cover ranged from 6 to 21% of the sample photograph for all samples but on average the percent cover was typically no more than 19%. Gastrapoda spp. 2 (a cone shell) was the most abundant species identified during the drop camera survey at the Geographe site. Analysis of photos from the drop camera study at Geographe showed that much of the epifauna is comprised of branching bryozoans, feather-like gorgonian cnidarians and sponges (Plate 5.1). This complex of encrusting/branching fauna provides refuge for macrofauna such as amphipods, isopods, polychaete worms and molluscs. Grab sampling was not conducted at the Geographe location.

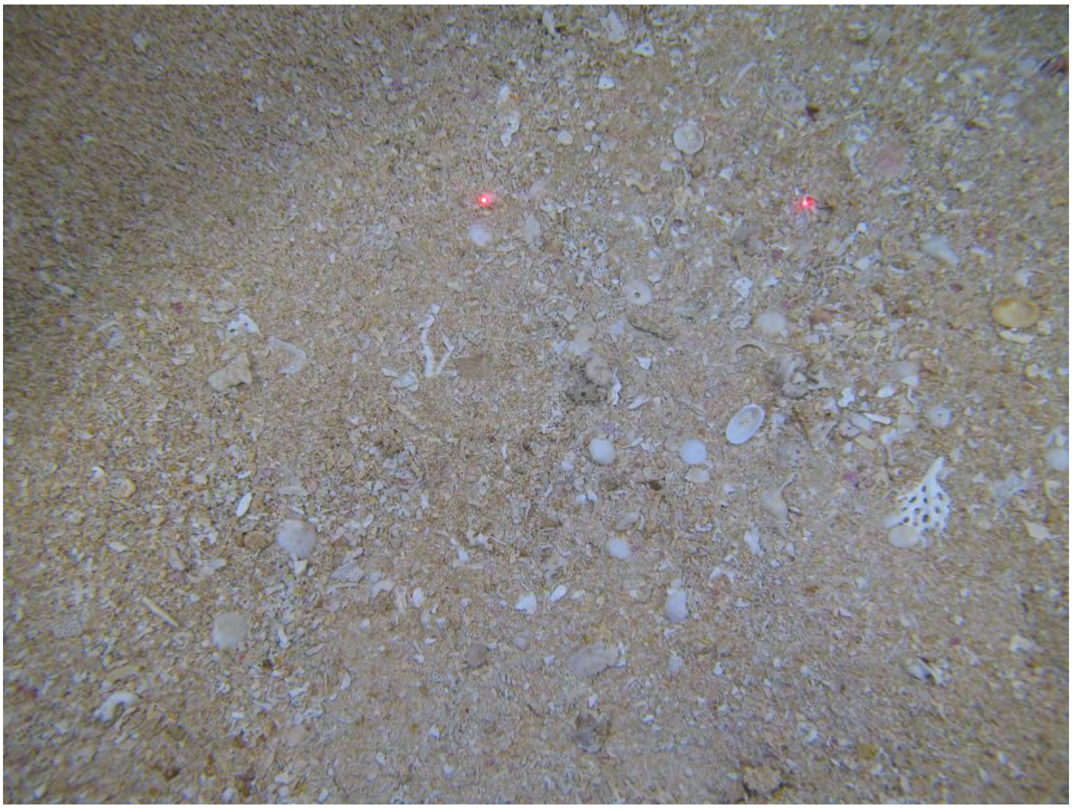
Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of an unmodified marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2. 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 Project studies (CEE, 2003; BBG, 2003) and Boreen et al (1993) concerning the subsea features and biological communities likely to dominate the EMBA and activity area. In summary the seabed of the activity area and EMBA can be characterised as a carbonate mid shelf and deeper sections 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.

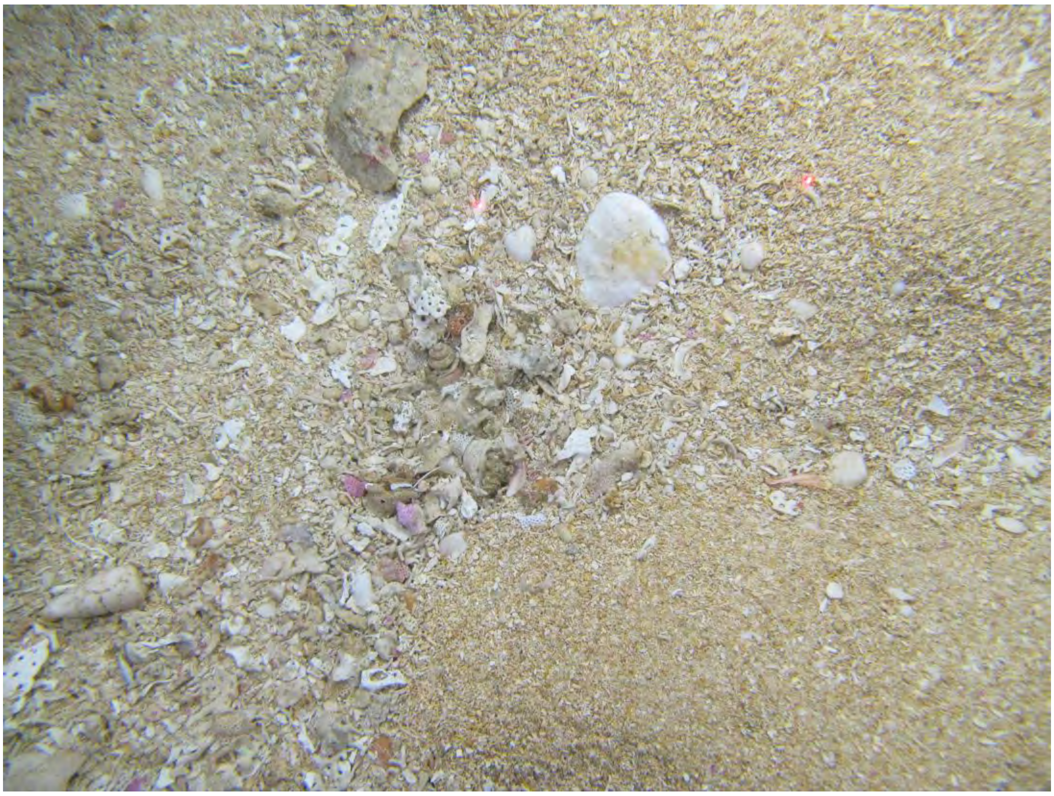
Plate 5.1. Seabed adjacent the activity area (Ramboll, 2020)

Geographe Assessment Site 1 – located 500 m southwest of the activity area.



Geographe Assessment Site 2 – located 500 m east of the activity area.

Geographe Assessment Site 3 – located 500 m northeast from the activity area



Geographe Assessment site 4 – located 500 m west from the activity area

The spill EMBA extends to coastal waters that have not been subject to targeted seabed assessments conducted by Beach or other petroleum titleholders. The seabed in the nearshore parts of the spill EMBA is mapped only at a coarse scale for the Oil Spill Response Atlas (OSRA) using LiDAR data. This section describes the seabed in the coastal waters intersected by the spill EMBA, broken down into OSRA mapping sections in Victoria (moving from the western parts of the spill EMBA to the eastern areas).

Victoria

- Discovery Bay (OSRA Map 01) – the nearshore seabed is predominantly sandy sediments. Areas of shallow water rocky reef is present around Nelsons Reefs and Noble Rocks adjacent the Glenelg River estuary and the Victoria-South Australia border.
- Portland (OSRA Map 02) – the nearshore seabed adjacent Cape Bridgewater, Cape Nelson and Point Danger is dominated by rocky substrate and associated reef habitat. In Bridgewater Bay, the sheltered cove is associated with nearshore sandy sediments and a lack of rocky substrate. East of Portland are several known nearshore reef sites including Minerva Reef and Julia Reef.
- Port Fairy (OSRA Map 03) – west of the Eumeralla River estuary, the nearshore seabed (up to 10 m water depth) is primarily sandy sediments. Beyond 10 m water depths, rocky substrate is dominant. East of the estuary until Port Fairy, there is hard substrate and reef sites including Mills Reef, The Crags and Port Fairy Reefs. The Crags are noted as a site of high diversity and abundance of seaweeds, molluscs and *Aplysia* spp.
- Port Fairy and Warrnambool (OSRA Map 04) – East of Port Fairy, the nearshore seabed is dominated by a mix of gently sloping sandy sediments and rocky reef sites. At Merri Marine Sanctuary, there are large macrocystis beds inshore from Hopkins Bank, which is located south of Warrnambool.
- Port Campbell (OSRA Map 05) – the nearshore seabed east of Warrnambool until Port Campbell features extensive areas of rocky substrate with only some areas of sandy sediments, most notably at Murnane Bay and Newfold Bay. Known rocky reef habitat is present at The Arches Marine Sanctuary
- Cape Otway West (OSRA Map 06) – The nearshore seabed at the Twelve Apostles Marine National Park is a mix of gently sloping sandy sediments, hard substrate and known rocky reef sites. There are extensive areas of nearshore rocky reef south of Cape Otway and is recognised abalone habitat.
- Apollo Bay (OSRA Map 07) – Immediately south of Cape Otway is an extensive area of reefs interspersed with sandy substrate, east of Cape Otway are areas dominated by sandy sediment in the nearshore environment.
- Lorne (OSRA Map 08) – the nearshore seabed at Apollo Bay is characterised by gently sloping sandy sediments and an absence of reef habitat. To the east, nearshore reef habitat is common with sandy sediments dominant further away from the coast. Cape Patton, Point Hawdon and Point Grey are the exception to this general pattern, whereby reef habitat is dominant throughout the mapped nearshore area.
- Anglesea (OSRA Map 09) – From Fairhaven to Jan Juc the nearshore environment is primarily sandy with subtidal rocky reef habitat present further away from the coast. Adjacent Torquay, subtidal rocky reef is dominant within the Point Danger Marine Sanctuary.
- Bellarine Peninsula South (OSRA Map 10) - East of Torquay to Point Lonsdale, the nearshore sediments are mainly sandy with subtidal rocky reef habitat dominant further away from the shoreline. Within Port Phillip Bay, the northern Mornington Peninsula coast is dominated by an uninterrupted extent of nearshore sandy sediments from Point Nepean to Sorrento.
- Mornington Peninsula South (OSRA Map14) - the nearshore seabed of the southern Mornington Peninsula coast from Point Nepean to Flinders is predominantly subtidal rocky reef and rocky substrate with intermittent patchy areas of sandy sediments. East of Flinders, aquatic vegetation is present in the nearshore environment among sandy sediments and an absence of hard substrate.

- Phillip Island (OSRA Map 15) – the southern coast of Phillip Island is a mix of subtidal rocky reef in exposed sections of nearshore seabed and sandy sediments in sheltered bays and coves. The northern coast of Phillip Island is not intersected by the EMBA.
- Kilcunda (OSRA Map 17) – the nearshore seabed south of Kilcunda is dominated by rocky substrate with only sparse areas of sandy sediment present.
- Cape Liptrap (OSRA Map 18) – the nearshore seabed adjacent Cape Liptrap is primarily sandy sediments with some areas of subtidal rocky reef.
- Wilsons Promontory West (OSRA Map 19) – the western parts of Wilsons Promontory intersected by the EMBA are dominated by sandy sediments, with small and isolated areas of reef clustered around the offshore islands.

South Australia

The EMBA intersects a small area of the South Australian nearshore environment at Port MacDonnell. Descriptions of the seabed in this remote area are limited though the Lower South East Marine Park, located 4 km east of Port MacDonnell, notes that the park contains reef systems and kelp forests, which indicates the presence of extensive hard substrate in the nearshore environment (DEWNR, 2012).

The following information provides a description of the key seabed features listed above.

Subtidal rocky reef

Rocky reefs provide a stable seabed for a wide range of plants and animals including kelps and other seaweeds and encrusting invertebrates such as sea squirts, sponges and bryozoans. In turn fixed biota provide habitat and food for mobile animals including molluscs, octopus, crustaceans, and a wide range of fish species. There have been a wide range of studies of nearshore reef biota in Victoria including work for the Environment Conservation Council's marine coastal and estuarine investigation (Ferns and Hough, 2000). The nearshore reefs along Victoria's open coastline are characterised by an abundance of brown kelps, with a diverse understorey of red, green and brown seaweeds, sea squirts, sponges, bryozoans, crustaceans and molluscs. There is a degree of variation in the composition of biota on the reefs along the coast but in general most species are represented widely along the Victorian coast. Parks Victoria (2006a) notes that the Bunurong MNP and Bunurong Marine Park (both sites with significant areas of subtidal rocky reef and rock platforms) have the highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone.

Sandy substrate

The shifting sands of unsheltered nearshore seabed are often too mobile for the development of marine floral communities and lack the necessary hard substrate required for anchoring. As such, these environments can appear barren and featureless on the surface. Nevertheless, a rich abundance of faunal communities may be present among the sands including species of molluscs, bivalves, annelids, crustaceans, and echinoderms.

5.3.9 **Shorelines**

This section briefly describes the shoreline in the areas intersected by the spill EMBA (entrained phase), moving west to east. There is no shoreline loading predicted under the MDO spill scenario.

South Australia

- Port MacDonnell – The EMBA intersects approximately 15 km of the southern coast of South Australia. East of Port MacDonnell is a 3.5 km stretch of sandy beach prior to the town itself and its harbour. Rugged cliffs and rocky shorelines are dominant west of Port MacDonnell with stretches of sandy beach present only in sheltered bays and coves, abutted further west by the Douglas Point Conservation Park.

Victoria

- Discovery Bay (OSRA Map 01) – The Discovery Bay shoreline is an uninterrupted stretch of sand beach backed by extensive swamps and oxbow lakes. The Glenelg River estuary is intermittently open and is the only estuary in the area. The sand beach and swamps are important sites for shorebirds including hooded plovers and provides habitat for orange-bellied parrots.
- Portland (OSRA Map 02) – The coast west of the township of Portland in defined by three rocky headlands that extent into the sea, namely, Cape Bridgewater, Cape Nelson and Point Danger. The shoreline of these headlands is distinctly rugged with sand beaches accumulating only in sheltered coves. East of Portland is a long stretch of sand beach that is interrupted only by the Surry River estuary, which is intermittently open.
- Port Fairy (OSRA Map 03) – Sandy beaches are the dominate coastal feature west of Port Fairy along with the Eumeralla River estuary (intermittently open) and Yambuk wetlands. Adjacent the township of Port Fairy the coastline is a mix of intertidal shore platform and sand beaches.
- Port Fairy and Warrnambool (OSRA Map 04) – Between the townships of Port Fairy and Warrnambool, there are extended areas of sandy beaches with numerous sites of recognised shorebird habitat. The Belfast Coastal Reserve is also present in this area and the Hopkins River estuary (intermittently open).
- Port Campbell (OSRA Map 05) – The dominant coastline feature west of Port Campbell is a mix of sand beach and intertidal shore platform as well as the Curdies River estuary (intermittently open) and Curdies Inlet, which is a recognised site for shorebird and wading species.
- Cape Otway West (OSRA Map 06) - The shoreline south of Wattle Hill is dominated by rock platform with a short stretch of sandy beach located at Milanesia Beach. From Johana Beach until Point Flinders, sand beach is dominant with interspersed areas of rock platform as well the Johanna and Aire River Estuaries. At Cape Otway, there is extensive rock platform with interspersed areas of mixed sand beach and intertidal shore platform.
- Apollo Bay (OSRA Map 07) – East of Cape Otway, the shoreline is a mixture of sand beach and intertidal shore platform. Hooded plover habitat is identified from the Park River Estuary to Shelly Beach. From Marengo to Skenes Creek, sand beaches are dominant in the sheltered area of Apollo Bay. From Skenes Creek until Wye River, the shoreline is a mixture of sand beach and rock platforms, interspersed with the Smythes Creek, Carrisbrook Creek, Grey River and Kennet River Estuaries.
- Lorne (OSRA Map 08) - From Wye River to Lorne, the shoreline is characterised by a mixture of sand beach and intertidal shore platform with shorebird habitat identified throughout. At Lorne and Fairhaven, uninterrupted stretches of sand beach at present. Shorebird roosting and feeding is identified at the Painkalac Creek Estuary.
- Anglesea (OSRA Map 09) – From Anglesea to Barwon Heads, sand beach is the dominant shoreline type with intermittent stretches of rock platform and intertidal shore platform present. At the Anglesea River Estuary, shorebird feeding habitat has been identified as well as at Addiscot Beach, Thompson Creek Estuary and Thirteenth Beach.
- Bellarine Peninsula South (OSRA Map 10) – The Barwon River Estuary and shorebird roosting sites are present in this section and sand beach is dominant from Barwon Heads to St Leonards. The northern shoreline of the Mornington Peninsula is primarily sandy beach from Point Nepean to Sorrento with sparse areas of rocky intertidal shore platform.
- Morning Peninsula South (OSRA Map 14) - The southern Mornington Peninsula coastline from Point Nepean to Flinders is a mixture of sand beach and intertidal shore platform, with an uninterrupted stretch of sand beach present at Gunnamatta Beach. Shorebird habitat and feeding sites are identified in the Point Nepean National Park, Pelly Point, Cape Schanck, and West Head. North of Flinders towards Balnarring, a mixture of sand beach and intertidal shore platform is present along with numerous identified shorebird roosting sites, particularly around Shoreham.

- Phillip Island (OSRA Map 15) – the southern coast of Phillip Island is a mix of rocky shores and sandy beaches in sheltered coves. Cape Woolamai coast on the eastern edge of the island is dominated by sandy beach and sand dunes with some isolated areas of cobble/shingle beach. The sandy beach provides habitat for coastal bird species.
- Kilcunda (OSRA map 17) – The shoreline south of Kilcunda to Cape Patterson is dominated by intertidal shore platform and sandy beaches.
- Cape Liptrap (OSRA map 18) – The shoreline around Cape Liptrap is dominated by mixed sand beach/shore platform in the southern area, shifting to mixed cobble/shingle beach/shore platform on the western side of the cape.
- Wilsons Promontory West (OSRA map 19) – The western parts of Wilsons Promontory intersected by the EMBA are dominated by intertidal shore platforms and interspersed by sandy beaches, particularly in the bays (e.g., Oberon Bay, Norman Beach (Tidal River) and Darby Beach. The offshore islands in this sector (Kanowna, Cleft, Anser Group, Wattle, McHugh, Glennie Group and Norman islands) are all dominated by intertidal shore platforms and provide important breeding habitat for little penguins (see Section 5.5.4), Australian fur-seals and New Zealand fur-seals (see Section 5.5.6). All the islands are protected within the Wilsons Promontory Marine National Park (MNP) and Wilsons Promontory Marine Park.
- Wilsons Promontory East (OSRA Map 20) – The shoreline of Wilsons Promontory East is dominated by intertidal shore platform in areas exposed directly to the sea. Sheltered bays, such as Waterloo Bay and Sealers Cove, are dominated by sandy beach and mixed sand beach/shore platform. At these locations, Freshwater Creek estuary and Sealers Creek estuary meet Bass Strait.

Parks Victoria (2006a) notes that the following values of the shoreline types described for the spill EMBA (noting these are focused on the Bunurong MNP and Bunrong Marine Park areas):

- Sandy beaches – provide important habitat for invertebrates such as amphidpods, isopods, molluscs, polychaetes and crustaceans, while the beach-washed material (wrack) provides food sources for birds and detritus for invertebrates such as bivalves and crabs.
- Intertidal reef platforms and rocky shores – upper areas of the rock platforms support green, red and blue-green algae while the extensive mid-intertidal communities are dominated by Neptune's necklace (*Hormosira banksii*) and the green algae sea lettuce (*Ulva spp*.), which grow in small rock pools and cracks. Lower intertidal platforms that are subject to regular submergence are dominated by brown algae and branching and encrusting coralline red algae. The intertidal reef platforms are feeding and roosting areas for many shorebird species.

5.4 Biological Environment

The key source of information for the protected species that may be present in the spill EMBA is the results of the EPBC Act PMST.

5.4.1 Benthic Assemblages

Bass Strait

Marine invertebrates in Bass Strait include porifera (e.g., sponges), cnidarians (e.g., jellyfish, corals, anemones, seapens), bryozoans, arthropods (e.g., sea spiders), crustaceans (e.g., rock lobster, brine and fairy shrimps), molluscs (e.g., scallops, sea slugs), echinoderms (e.g., sea cucumbers), and annelids (e.g, polychaete worms). A description of these benthic invertebrates is provided in Table 5.9.

Table 5.9. Marine invertebrates that may be present in the activity area and spill EMBA

Invertebrate	Description
Porifora (Sponges)	Sponges are sessile, multicellular organisms that have bodies full of pores and channels allowing water to circulate through the animal which provides food and oxygen and remove wastes. The flow is actively generated by the beating of flagella and filter bacteria and phytoplankton from the water which passes through them (Bond & Harris, 1988). Porifera flourish in waters where water movement is strong (Butler *et al*., 2002). Sponges do not have nervous, digestive or circulatory systems and they reproduce by asexual and sexual means. Increasing temperature is generally accepted as a major environmental factor regulating the onset of reproduction activity particularly in regions of large seasonal change (spring/summer) (Fromont, 1993). Sponges are efficient colonisers of marine hard surfaces although they will not typically colonise a newly cleared surface as rapidly as some other groups (e.g., bryozoans). Once established sponges are effective competitors in retaining living space through asexual reproduction and by using chemicals to deter competitors and predators (Butler *et al*., 2002). Large sponges are a host to a myriad of commensal invertebrates including crustaceans, molluscs, worms and echinoderms as well as microorganisms. Only a few specialised species prey on sponges due to their highly developed chemical defences. For fish they are generally unpalatable but may present shelter and food in the form of associated species (Butler *et al*., 2002). Sponges were commonly observed at the Otway assessment sites during recent targeted seabed assessments (Ramboll, 2020).
Hydrozoans (Colony-forming polyps)	Hydrozoan species are found in almost every marine habitat type except heavy surf zones. They are most abundant and diverse in warm shallow waters probably reflecting food abundance. Most species have a planktonic larval stage which is pelagic before settling onto benthic substrates and developing a polyp. A founding polyp produces new polyps by budding. In many colonies, polyps are polymorphic with different structures reflecting different functions. Polyps produce 'adult' sexually-reproducing medusae which are free-swimming and release sperm and eggs in the water (broadcast spawners) where fertilisation occurs. Colonies are usually sessile benthic, but some notably the siphonophores are pelagic floaters. Most hydrozoans are predators or filter-feeders. Filter feeders trap small zooplankton, pelagic hydrozoans show selectivity in prey types taking mainly fish larvae, soft bodied invertebrates or micro-crustaceans. Predators can include snails, worms, fish and crustaceans (University of Michigan, 2018).
Bryozoans (Aquatic filter feeding animals)	Bryozoans are sessile, aquatic invertebrate filter feeding animals which attach to hard substrates and form lace-like colonies. They have no respiratory organs, heart, or blood vessels. Instead, they absorb oxygen and eliminate carbon dioxide through the body wall. Colonies of bryozoans are started by a single individual that, after its larval existence, settles onto a substrate and begins to reproduce asexually (by budding) after settlement. Bryozoans are hermaphrodites and fertilisation can be external in the water column or internal with embryos brooded in the body (as per ascidians) fertilised with sperm brought in on the feeding current. The larvae which are hatched are then released and swim but do not feed. They swim towards the light then after a few hours swim down to the seabed to colonise. For species which do not brood but release eggs, fertilised eggs become part of the plankton stream for approximately two months until they are large enough to descend and start a new colony (Earthlife, 2014). Temperature controls all aspects of bryozoan life. In spring, rising water temperatures and increased intensity of light stimulate phytoplankton growth which initiates active budding in bryozoans and to some degree sexual reproduction (Smithsonian Institute, 2016). Most bryozoans use chemicals as well as spines as a predator deterrent and thus have only relatively few specialised predators (Butler *et al*., 2002).

Invertebrate	Description
Annelids (worms)	Annelids are a large phylum of segmented worms, including polychaetes, clitellates, ragworms, earthworms and leeches. Polychaetes are brightly coloured segmented worms. Most are less than 10 cm long, although they can range from 1 mm to 3 m and include forms such as sand worms, tube worms and clam worms. They are found in all habitats from the supra-littoral to the deepest parts of the ocean. Some such as the feather-duster worms are sedentary, living in tubes buried in sand/mud and feed by trapping food particles in mucus or by ciliary action. Others such as the clam worm are active mobile predators which capture prey in jaws (University of Michigan, 2018). Most polychaetes have separate sexes - male and female and the sperm and eggs are released into the surrounding water through ducts or openings. The fertilised eggs hatch into larvae, which float among the plankton, and eventually metamorphose into the adult form by adding segments (MESA, 2017).
Ascidians	All ascidians (sea squirts) are sessile, sac-like marine invertebrate filter feeders and include both solitary and colonial species. These species have a digestive, circulatory and nervous system but lack any special sensory organs. Reproduction includes both asexual budding and sexual reproduction with a free-living larval stage. The species are hermaphrodites and fertilisation can be external with development in the water column (solitary species) or internal with embryos brooded in the body (colonial species). Solitary larvae are free-swimming for periods of 1 to 24 hours and prior to hatching have been floating free in the water for up to 3 days. They are therefore subject to current dispersal which contributes to gene flow and removes risks of isolation. The colonial species are seldom free swimming for more than one hour and attach to substrates rapidly. Limited information on predators is available but they include some fish, molluscs and sea-stars. As some species are known to contain toxins which deter predators and settling larvae, most solitary and colonial species a great ability to rapidly repair any damage through vegetative growth (Butler *et al*., 2002).
Molluscs (Gastropod – abalone)	Univalve gastropods can live for up to 20 years and grow to a shell length of over 20 cm. Abalone feed on algae and predators include crabs, rock lobster, octopi, fish and rays. Blacklip abalone is the predominant species which is fished in the area although greenlip abalone is also present. Blacklip abalone is found in shallow depths between 5 to 20 m and can be found in caves and crevices and on sheltered reefs. Greenlip abalone is found in shallow reef habitats (5 to 40 m) and rough water at the base of steep granite cliffs. Abalone is a broadcast spawner with spawning with the species spawning from Spring to Autumn (Kailola *et al*., 1993). Abalone habitat is present along the Cape Otway coast.

Invertebrate	Description
Crustaceans (krill)	Marine crustaceans form an extremely large, diverse arthropod taxon that includes animals such as crabs, lobsters, shrimps, prawns and krill. Like other arthropods, crustaceans have an exoskeleton, which they moult to grow. Crustaceans occupy a wide range of ecological niches, filling the roles of primary producers, predators and detritivores. Commercially important crustacean species include the southern rock lobster (*Jasus edwardsii*) and the giant crab (*Pseudocarcinus gigas)*. Krill (*Nyctiphanes australis*) is a common coastal species in southern Australian waters endemic to the subtropical convergence zone and play an important role in the ecological significance of upwelling events (see Section 5.5.7). The species has a maximum weight of approximately 0.02 g, a maximum length of 17 mm, and estimated life span of one year and has a depth distribution of surface to 150 m water depths (Nicol & Endo, 1999). Studies into the feeding habits of krill identified that the species consumed detritus, diatom and crustacean fragments and sponge spicules (Dalley and McClatchie, 1989). The species broods its eggs until they hatch rather than spawning them directly into the water column. *N. Australis* reaches sexual maturity after about four months and the female lays several broods of eggs in one season). *N. australis* is one of the most important dietary items for jack mackerel, short-tailed shearwater, fairy prion, Australian salmon, skipjack tuna and tiger flathead as well as other abundant fish and seabirds (Nicol and Endo, 1997).

Studies by the Museum of Victoria (Wilson and Poore, 1987; Poore *et al*., 1985) found that invertebrate diversity was high in southern Australian waters, and the distribution of species was irregular with little evidence of any distinct biogeographic regions. The results of invertebrate sampling undertaken in shallower inshore sediments indicate a high diversity and patchy distribution. In these areas, crustaceans, polychaetes, and molluscs were dominant (Parry *et al*., 1990).

Whilst there is little information available on the nature or distribution of epibiota in central Bass Strait, data is available for eastern Bass Strait from the Museum of Victoria biological sampling programs conducted from 1979 to 1984 (Wilson and Poore 1987), from scientific dredging conducted in 1989 (Parry *et al*., 1990), and from targeted investigations for pipeline and power link proposals in the area. This information can be used to extrapolate existing conditions for central Bass Strait.

Generally, the epibiota of the region is sparse and characterised by scallops and other large bivalve molluscs, crabs, seasquirts, seapens, sponges and bryozoans. A variety of mobile crabs, prawns and brittle stars are also relatively common. Many of the mobile epibiota appear to occur in aggregations from time to time (scallops, prawns and crabs) while some of the fixed epibiota occur in patches (sponges and bryozoans). For example, trawling conducted for the Museum of Victoria biological sampling programs recorded large hauls of sponges along some trawl transects. The main hauls of sponges were located in an arc around southern Bass Strait (Butler *et al*., 2002).

Activity Area

The PMST results do not identify any benthic species. However, benthic species were encountered during the Ramboll (2020) survey, which are presented in Section 5.3.8. The Bunurong MNP, located 238 km east of the activity area near Kilcunda in Victorian state waters, has extensive intertidal rock platforms that exhibit a diverse range of marine life. The subtidal rocky reefs include numerous microhabitats extending several kilometres offshore in relatively shallow water (Parks Victoria, 2006a).

The diversity of intertidal and shallow subtidal invertebrate fauna is the highest recorded in Victoria on sandstone. A high proportion of the common invertebrates occurring along the Victorian coast are found in the Bunurong MNP (Parks Victoria, 2006a), which is also described in Table 5.17. For example:

- Seven of the eight species of brittle stars;

- Nine of 11 sea cucumbers;
- Eight of 11 barnacles;
- All five sea anemones; and
- 15 of 20 chitons (flat eight-plated grazing molluscs).

The underwater reefs in the Bunurong MNP look different to those in other parts of Victoria. For example, crayweed, a large brown seaweed that covers many Victorian reefs, is mostly absent here. Instead, a multitude of more unusual plants and animals flourish. The species richness of the Bunurong seaweeds is comparatively high and includes green, blue-green, brown and encrusting coralline red algal species (Parks Victoria, 2006a). The subtidal marine flora of the area is characterised by a mixed group of brown, red and green algae. The seagrass *Amphibolis antarctica* is also an important component. Invertebrates found in the subtidal zone include limpets, barnacles, blacklip abalone, crabs, seastars, urchins, feather stars and brittle stars, sea snails and small crustaceans (Parks Victoria, 2006a).

5.4.2 Plankton

Plankton is a key component in oceanic food chains and comprises two elements; phytoplankton and zooplankton, as described herein. Phytoplankton (photosynthetic microalgae) comprise 13 divisions of mainly microscopic algae, including diatoms, dinoflagellates, gold-brown flagellates, green flagellates and cyanobacteria and prochlorophytes (McLeay *et al*., 2003). Phytoplankton drift with the currents, although some species have the ability to migrate short distances through the water column using ciliary hairs. Phytoplankton biomass is greatest at the extremities of Bass Strait (particularly in the northeast, outside the EMBA) where water is shallow, nutrient levels are high and ocean currents facilitate occasionally planktonic blooms.

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 particular 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 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.

5.4.3 Marine Flora

Literature searches indicate there is a paucity of public information regarding the distribution and abundance of marine flora in Bass Strait, particularly in relation to the deeper water of the activity area and spill EMBA. The Ramboll (2020) survey did not specifically assess for marine flora.

The subtidal and intertidal rocky reefs of Bass Strait, located closer to the shoreline, are understood to have a high diversity of plant species including seagrasses and macroalgae. In sheltered parts of shallow bays, inlets and estuaries, seagrasses establish extensive underwater meadows that are critical in the early life stages of many fish species. Seagrasses trap soil and other material washed from the land by binding them together and stopping it from clouding the water column, which would otherwise prevent sunlight reaching plants on the seabed.

Variation exists among rocky reefs depending on the level of exposure to waves, the rock type, its weathering and the presence of rock pools, crevices and boulders which all in turn determine the composition of marine fauna. In the nearshore environment, seaweed forests are made up of a large brown kelp. In these environments the marine plants attach themselves to solid structures and extend their blades into the waters reaching toward the sunlight. Together the plants form a dense canopy of blades blocking out light and shading the surface of the solid substrate allowing for smaller species of algae to form. The kelp species typically populating these forests include giant kelp (*Macrocystis pyrifera*) and bull kelp (*Durvillea potatorum*). Along the Otway coast, kelp and seagrasses are a prominent part of the nearshore subtidal reefs. Common kelp (*Ecklonia radiata*) and crayweed (*Phyllospora comosa*) are found along the open coast in dense stands. Giant species of seaweeds such as string kelp (*Macrocystis pyrifera*) and bull kelp also occur.

5.4.4 Birds

The EPBC Act PMST identifies 58 bird species as threatened or migratory whose habitat or migratory pathway may occur within the EMBA (listed in Table 5.10). The results of the PMST primarily comprise 16 albatross, seven petrels, two parrots, three shearwaters, one godwit, three terns, two curlew, one prion, four snipes, three gulls, one plover, and four sandpipers.

Four of these bird species are listed as critically endangered, seven are endangered and 22 are listed as vulnerable.

Many of the bird species listed in Table 5.10 are protected by international agreements (Bonn Convention, JAMBA, CAMBA and ROKAMBA) and periodically pass through the Otway region to and from the Bass Strait islands, mainland Victoria and Tasmania (DAWE, 2020b). Species listed as threatened are described in this section. Figure 5.13 illustrates the presence of these bird species throughout the year. Twenty-seven (27) of the species presented in Table 5.10 were recorded in the search for the EMBA area only and were not identified to occur within the activity area.

Table 5.10.EPBC Act-listed bird species that may occur within the activity area and spill EMBA

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
True seabirds (35 species)							
Albatross							
Diomedea antipodensis	Antipodean albatross	V	Yes	Yes	-	FFR	Generic RP in place for all albatross in Australia,
Diomedea gibsoni	Gibson's albatross	V	Yes	Yes	Yes	-	
Diomedea epomophora (sensu stricto)	Southern royal albatross	V	Yes	Yes	-	-	
Diomedea exulans (sensu lato)	Wandering albatross	V	Yes	Yes	-	FFR	
Diomedea sanfordi	Northern royal albatross	E	Yes	Yes	-	-	

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Phoebetria fusca	Sooty albatross	V	Yes	Yes	-	-	+ AS for all albatross
Thalassarche bulleri	Buller's albatross	V	Yes	Yes	-	FFR	
Thalassarche bulleri platei	Northern Buller's albatross	V	-	-	-	-	
Thalassarche cauta	Shy albatross	V	Yes	Yes	-	FFR	
Thalassarche cauta steadi	White-capped albatross	V	Yes	Yes	Yes	-	
Thalassarche chrysostoma	Grey-headed albatross	E	Yes	Yes	-	-	
Thalassarche impavida	Campbell albatross	V	Yes	Yes	-	FFR	
Thalassarche melanophris	Black-browed albatross	V	Yes	Yes	-	FFR	
Thalassarche salvini	Salvin's albatross	V	Yes	Yes	-	-	
Thalassarche steadi	White-capped albatross	V	Yes	Yes	-	-	
Thalassarche sp. Nov.	Pacific albatross	V	-	Yes	-	-	
Petrels							
Fregetta grallaria grallaria	White-bellied storm-petrel	V	-	-	-	-	-
Halobaena caerulea	Blue petrel	V	-	Yes	-	-	-
Macronectes giganteus	Southern giant petrel	E	Yes	Yes	-	-	Generic RP and AS for giant petrels
Macronectes halli	Northern giant petrel	V	Yes	Yes	-	-	
Pterodroma leucoptera leucoptera	Gould's petrel	E	-	-	-	-	RP
Pelecanoides urinatrix	Common diving petrel	-	-	Yes	Yes	FFR	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Pterodroma mollis	Soft-plumaged petrel	V	-	Yes	-	-	CA
Other seabirds							
Ardenna carneipes	Flesh-footed shearwater	-	Yes	Yes	-	-	-
Ardenna grisea	Sooty Shearwater	-	Yes	Yes	-	-	-
Ardenna tenuirostris	Short-tailed shearwater	-	Yes	Yes	Yes	B, FFR	-
Catharacta skua	Great skua	-	-	Yes	-	-	-
Haliaeetus leucogaster	White-bellied sea-eagle	-	-	Yes	Yes	-	-
Pachyptila turtur subantarctica	Fairy prion (southern)	V	-	-	-	-	CA
Pandion haliaetus	Osprey	-	Yes	Yes	Yes	-	-
True shorebirds (53 species)							
Actitis hypoleucos	Common sandpiper	-	Yes	Yes	-	-	-
Anous stolidus	Common noddy	-	Yes	Yes	Yes	-	-
Apus pacificus	Fork-tailed swift	-	Yes	Yes	Yes	-	-
Ardea alba	Great egret	-	-	Yes	Yes	-	-
Ardea ibis	Cattle egret	-	-	Yes	Yes	-	-
Botaurus poiciloptilus	Australasian bittern	E	-	-	Yes	-	CA
Calidris acuminata	Sharp-tailed sandpiper	-	Yes	Yes	-	-	-
Calidris canutus	Red knot	E	Yes	Yes	-	-	CA
Calidris ferruginea	Curlew sandpiper	CE	Yes	Yes	-	-	-
Calidris melanotos	Pectoral sandpiper	-	Yes	Yes	-	-	-
Eudyptula minor	Little penguin	-	-	Yes	Yes	B, F	-
Gallinago hardwickii	Latham's snipe	-	Yes	Yes	Yes	-	-
Gallinago megala	Swinhoe's snipe	-	Yes	Yes	Yes	-	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Gallinago sternura	Pin-tailed snipe	-	Yes	Yes	Yes	-	-
Larus dominicanus	Kelp gull	-	-	Yes	Yes	-	-
Larus novaehollandiae	Silver gull	-	-	Yes	Yes	-	-
Larus pacificus	Pacific gull	-	-	Yes	Yes	-	-
Lathamus discolour	Swift parrot	CE	-	Yes	Yes	-	-
Limosa lapponica baueri	Bar-tailed godwit	V	Yes	Yes	Yes	-	-
Neophema chrysogaster	Orange-bellied parrot	CE	-	Yes	Yes	-	RP
Numenius madagascariensis	Eastern curlew	CE	Yes	Yes	-	-	CA
Numenius minutus	Little curlew	-	Yes	Yes	Yes	-	-
Rostratula australis	Australian painted snipe	E	-	Yes	Yes	-	CA
Sterna (Sternula) albifrons	Little tern	-	Yes	Yes	Yes	-	-
Sterna (Sternula) nereis nereis	Australian fairy tern	V	-	-	-	-	CA
Thalasseus bergii	Crested tern	-	Yes	Yes	Yes	-	-
Thinornis rubricollis rubricollis	Hooded plover (eastern)	V	-	Yes	Yes	-	CA
Tringa nebularia	Common greenshank	-	Yes	Yes	Yes	-	-

Definitions	
Listed threatened species:	A native species listed in Section 178 of the EPBC Act as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
Listed migratory species:	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the EPBC Act.
Listed marine species:	As listed in Section 248 of the EPBC Act.

Key		
EPBC Act status (@ January 2021)	V	Vulnerable
	E	Endangered
	CE	Critically endangered
BIA (Biologically Important Area)	A	Aggregation
	B	Breeding
	D	Distribution (i.e., presence only)
	F	Foraging
	FFR	Foraging, feeding or related behaviour
	M	Migration
	R	Roosting
	CH	Connecting habitat
Recovery plans	AS	Action Statement
	CA	Conservation Advice
	CMP	Conservation Management Plan
	RP	Recovery Plan

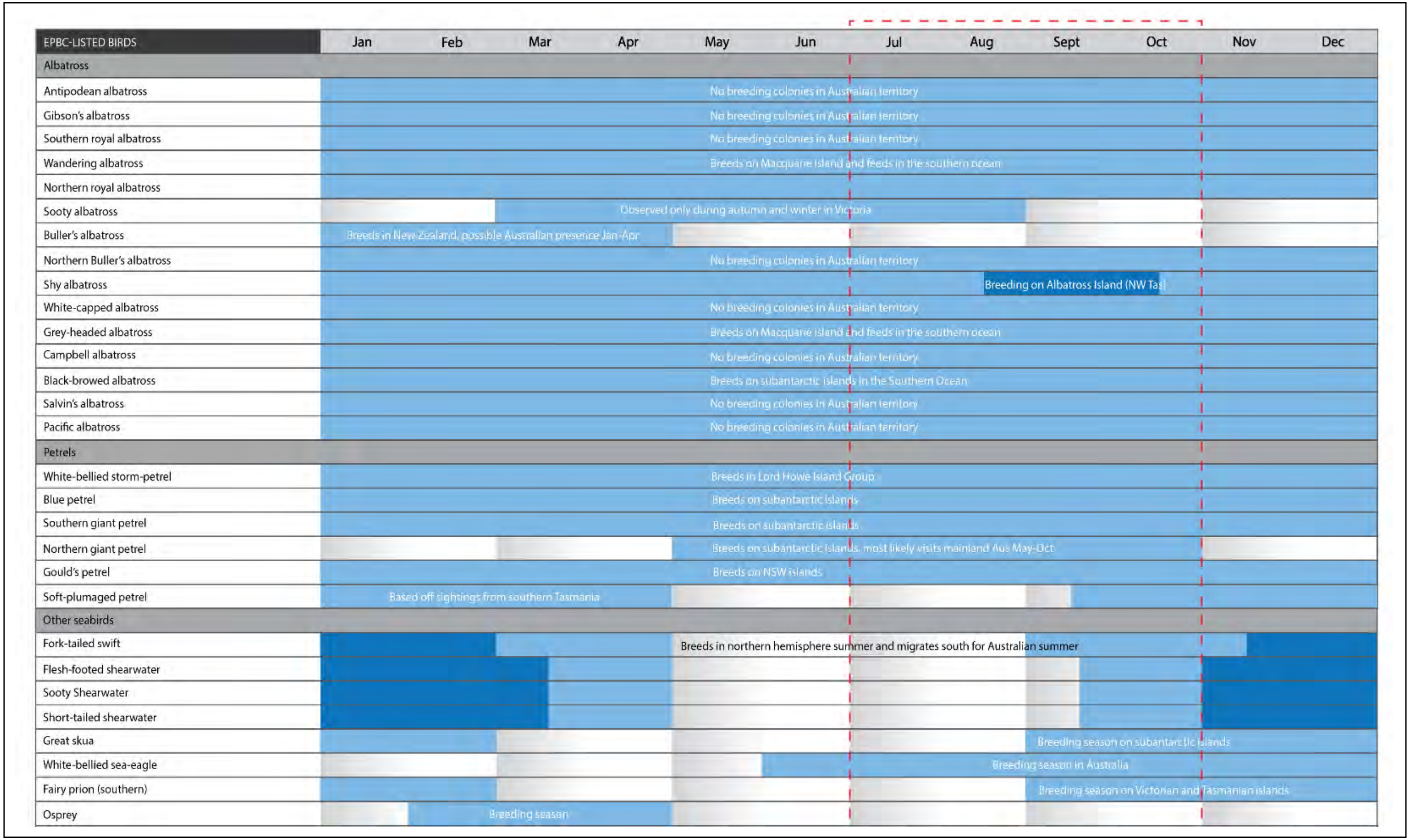


Figure 5.13. The annual presence and absence of seabirds and shorebirds in the spill EMBA.

Figure 5.13 (cont'd). The annual presence and absence of seabirds and shorebirds in the spill EMBA.

True seabirds

Albatross and Petrels

Albatrosses and giant petrels are among the most dispersive and oceanic of all birds, spending more than 95% of their time foraging at sea in search of prey and usually only returning to land (remote islands) to breed. Only seven species of albatross and the southern and northern giant petrel are known to breed within Australia, which are protected under The National Recovery Plan for 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 (all outside the EMBA) (DSEWPaC, 2011b). There are no islands with colonies of threatened marine seabirds within the EMBA. Albatross Island (203 km southeast of the activity area), supporting a breeding population of approximately 5,000 shy albatrosses (*Thallassarche cauta*), is the closest breeding colony of threatened seabirds to the spill EMBA.

Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is those waters south of 25 degrees where most species spend most of their foraging time. The antipodean albatross, black-browed albatross, Buller's albatross, Campbell albatross, shy albatross and wandering albatross, have BIAs for foraging that overlap the EMBA. These BIAs cover either most or all the SEMR (DAWE, 2020b). Therefore, it is likely that these will be present and forage in the spill EMBA but unlikely in the activity area.

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, 2011a). 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 albatross is 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, 2011a). 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, 2011a). Gibson's albatross has breeding colonies in New Zealand but has been known to forage in the Tasman Sea and South Pacific Ocean with individuals occurring offshore from Coffs Harbour in the north to Wilson's Promontory in the south (EA, 2001; Marchant & Higgins 1990). Therefore, it is likely that these species, along with the shy albatross will be present and forage in the spill EMBA.

The common diving-petrel is not listed as threatened under the EPBC Act, and has a large population 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). A BIA for foraging has been identified for the common diving-petrel that overlaps with the activity area and EMBA.

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, 2020)

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 surfaceseizing 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 (1,915 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 EMBA.

Shearwaters (Sooty, flesh-footed, short-tailed)

Shearwaters are medium-sized long-winged seabirds most common in temperate and cold waters. They come to islands and coastal cliffs to breed, nesting in burrows and laying a single white egg. Shearwaters feed on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), and other soft-bodied invertebrates and offal. These species forage almost entirely at sea and very rarely on land (TSSC, 2014).

The three EPBC Act-listed species (sooty, flesh-footed and short-tailed) are trans-equatorial migrants that cross the Pacific Ocean for the northern hemisphere summer (TSSC, 2014). It is possible these species may overfly the EMBA. Of the three species, the short-tailed is most likely to be encountered in the spill EMBA due to the proximity of breeding locations among the Furneaux Group (Flinders Island, etc).

Little penguin

There is a little penguin BIA (breeding and foraging) that is intersected by the spill EMBA, which is displayed in Figure 5.14. Little penguins are known to breed throughout southern Australia from Western Australia to New South Wales, including Bass Strait and Tasmania. 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 5.11 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). It is possible that little penguins move through the activity area and highly likely that they foraging and travel through the EMBA.

Table 5.11. 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

True Shorebirds

Plovers

Plovers feed on a range of molluscs, worms, crustaceans and insects. Plovers (with the exception of the hooded and red-capped lovers) 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 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, 2020). The extensive sandy beaches of the southwest Victorian coast are recognised habitat for the hooded plovers.

Terns

There are three EPBC Act-listed tern species that may occur within the spill EMBA (fairy, little, and crested). The fairy tern may also occur in the activity area. Many of the tern species present along the southern Australian coastline are widespread and occupy beach, wetland, grassland and coastal habitats. Terns rarely swim; they hunt for prey in flight, dipping to the water surface or plunge-diving for prey usually small baitfish in coastal waters and typically close to land (DSEWPC, 2011b).

The NCVA (DAWE, 2020c) indicates that the foraging BIA for the fairy tern (*Sterna nereis nereis*) (listed as vulnerable under the EPBC Act) occur in and offshore of the gulfs of South Australia (outside the EMBA). They are also known to breed on the offshore islands and coast of Spencer Gulf (outside the EMBA) (Edyvane, 1999). Flegg (2002) reports that the species is widespread on southern and western Australian coasts, and breeds on coastal beaches and islands.

The little tern (listed as migratory and marine under the EPBC Act) has an estimated population of 3,000 breeding pairs in eastern Australia (DAWE, 2020b). It is a migratory species that breeds in eastern Australia during spring and summer, leaving the colonies in late summer-autumn and vacating southern Australia (Birdlife Australia, 2020). In eastern Australia, breeding normally occurs within wetland areas. Little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths, lakes and exposed ocean beaches (Birdlife Australia, 2020). Habitat for this species occurs at the Gippsland Lakes, Corner Inlet and Westernport Bay. Little terns feed on small fish, crustaceans, insects and molluscs by plunging in shallow water or gleaning from the water surface. The little tern may occur within the EMBA.

The crested tern (*Thalasseus bergii*) is widely distributed around the coast of Australia and breeds on offshore islands in nests densely packed together. The crested tern lives along the coast of ocean beaches and in coastal lagoons. The species rarely flies far from shore out to sea or inland. It flies above the water in search of prey on the surface before plunging down to take small fish from the surface (Birdlife Australia, 2020). Due to its known distribution in Bass Strait, it is likely that the crested tern will be present in the spill EMBA.

Sandpipers

There are four EPBC Act-listed sandpiper species (common, sharp-tailed, curlew, pectoral) that may occur within the activity area and the 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 EMBA) (DoE, 2015b). 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 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 if no confirmed records of the pin-tailed and Swinhoe's snipe in Victoria (Birdlife Australia, 2020), while the Australian painted snipe is known to occur at Mallacoota Inlet (outside the 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 (292 km northeast from the activity area, outside the EMBA) and Westernport (214 km northeast from the activity area, within the 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 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).

Swift parrot

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 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, this species is unlikely to land within the spill EMBA though is likely to overfly on its migration to mainland Australia.

Bar-tailed godwit

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, 2020). They have been recorded eating annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs, and occasionally seeds. The Nooramunga Marine and Coastal Park (outside the EMBA) has recorded the largest concentrations of bar-tailed godwit (*Limosa lapponica*) in south-eastern Australia.

Orange-bellied parrot

The orange-bellied parrot (*Neophema chrysogaster*) breeds in Tasmania during summer, migrates north across Bass Strait in autumn and over-winters on the mainland. 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, 1999). The parrot's breeding habitat is restricted to southwest Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast (DEWLP, 2016). The species forage on the ground or in low vegetation (Brown and Wilson, 1980; DEWLP, 2016, Loyn *et al*., 1986).

During winter, on mainland Australia, orange-bellied parrots are found mostly within 3 km of the coast (DELWP, 2016). In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries, or, rarely, saltworks. 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*).

Most known breeding activity occurs within 10 km of Melaleuca Lagoon (Tas), outside of the spill EMBA. Key non-breeding habitat is known to occur around Corner Inlet in Victoria (outside the EMBA). King Island is known as a key location in the migration route between breeding and non-breeding sites, principally within the Lavinia State Reserve, which is located outside the EMBA (DELWP, 2016).

Red knot

Red knots have a coastal distribution around the entire Australian coastline when they are present during the southern hemisphere summer (breeding in eastern Siberia in the northern hemisphere summer). Knots are a medium-sized wader that prefer sandy beach, tidal mudflats and estuary habitats, where they feed on bivalve molluscs, snails, worms and crustaceans (Birdlife Australia, 2020). Lake Reeve (outside the EMBA) has supported the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria.

Australasian bittern

The Australasian bittern (*Botaurus poiciloptilus*) was recorded in the EMBA by the PMST. The Australasian bittern is a large, stocky, heron-like bird that occurs from southeast Queensland to southern South Australia. 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 coastal areas of the EMBA though it is unlikely.

Egrets

Two species of egret (little and plumed) are recorded in the EMBA. The plumed egret (*Ardea intermedia plumifera*) is primarily found in freshwater swamps, billabongs, floodplains and wet grasslands and as such is unlikely to be present in the EMBA. The little egret (*Egretta garzetta*) frequents tidal mudflats, saltwater and freshwater wetlands, and mangroves. Little egrets feed on a wide variety of invertebrates, as well as fish and amphibians. Due to its preference for coastal and saltwater habitats, the little egret may be encountered in coastal areas of the EMBA.

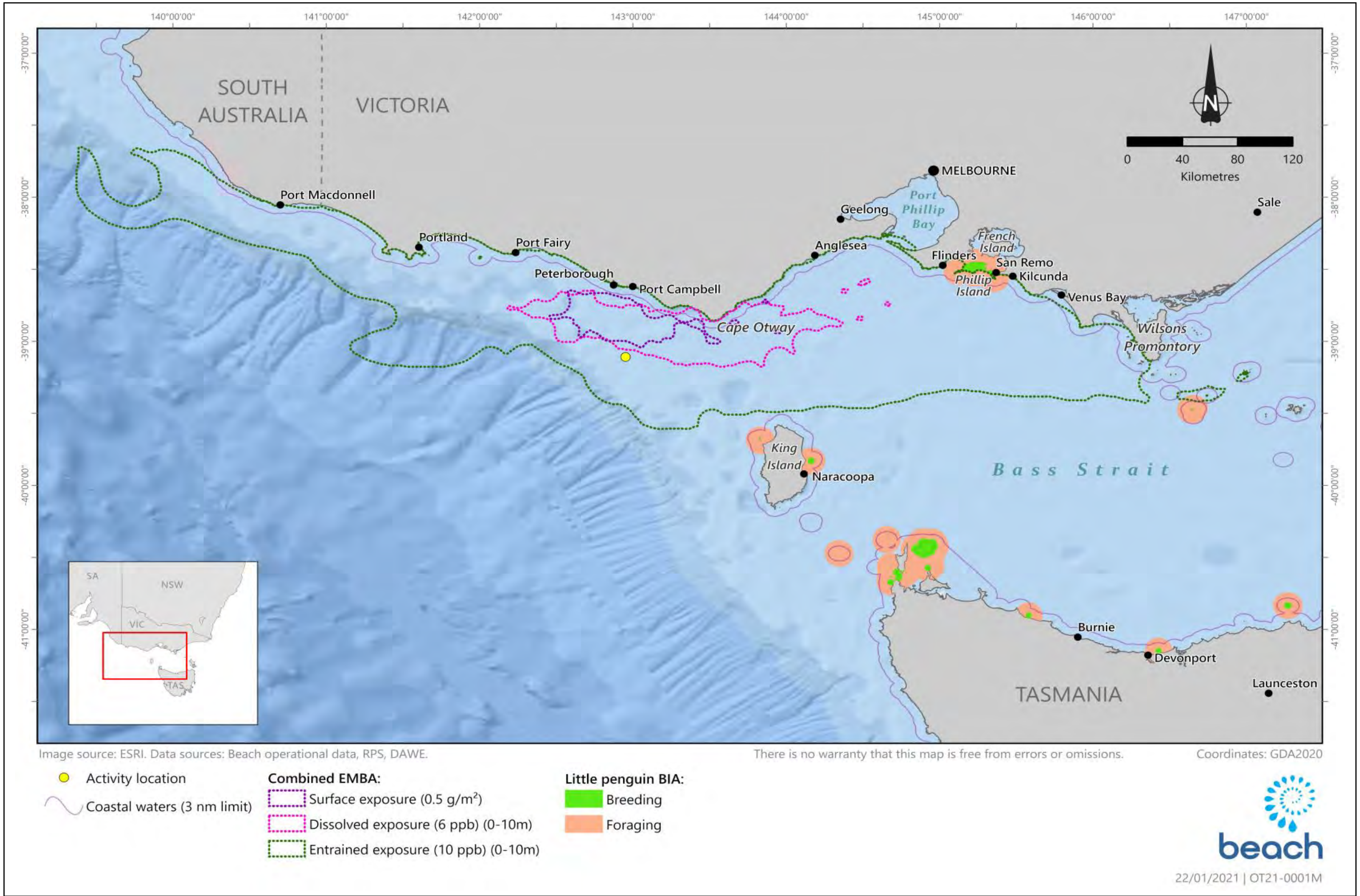


Figure 5.14. Little penguin breeding and foraging BIA

5.4.5 Cetaceans

The PMST identified 22 whale species and eight dolphin species that may reside within or migrate through the activity area and spill EMBA. These species are listed in Table 5.12. Of these, 14 whale and two dolphin species were recorded in the PMST search for the EMBA only and were not recorded in the activity area. A description of species listed in Table 5.12 is focused on threatened species. Figure 5.15 illustrates the presence and absence of the threatened cetacean species in the EMBA throughout the year.

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) (Figure 5.18 and Figure 5.19).

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. Survey effort was biased toward coverage of upwelling seasons, corresponding with pygmy blue whales' seasonal occurrence (November to April; 103 of 123 surveys), and relatively little survey effort occurred during 2008–2011. Cetacean species sighted within the region are described in the following sections.

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

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

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

Table 5.12. EPBC Act-listed cetaceans that may occur within the activity area and spill EMBA

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Whales							
Balaenoptera acutorostrata	Minke whale	-	-	Yes	-	-	-
Balaenoptera borealis	Sei whale	V	Yes	Yes	-	-	CA
Balaenoptera bonaerensis	Antarctic Minke Whale	-	Yes	Yes	Yes	-	-
Balaenoptera edeni	Bryde's whale	-	Yes	-	Yes	-	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Balaenoptera musculus	Blue whale	E	Yes	Yes	-	F, D	RP
Balaenoptera physalus	Fin whale	V	Yes	Yes	-	-	CA
Erardius arnuxii	Arnoux's beaked whale	-	-	Yes	Yes	-	-
Caperea marginata	Pygmy right whale	-	Yes	Yes	-	-	-
Eubalaena australis	Southern right whale	E	Yes	Yes	-	M, D, A, CH	CMP
Globicephala macrorhynchus	Short-finned pilot whale	-	-	Yes	-	-	-
Globicephala melas	Long-finned pilot whale	-	-	Yes	Yes	-	-
Kogia breviceps	Pygmy sperm whale	-	-	Yes	Yes	-	-
Kogia simus	Dwarf sperm whale	-	-	Yes	Yes	-	-
Megaptera novaeangliae	Humpback whale	V	Yes	Yes	-	-	CA
Mesoplodon bowdoini	Andrew's beaked whale	-	-	Yes	Yes	-	-
Mesoplodon densirostris	Blainville's beaked whale	-	-	Yes	Yes	-	-
Mesoplodon grayi	Gray's beaked whale	-	-	Yes	Yes	-	-
Mesoplodon hectori	Hector's beaked whale	-	-	Yes	Yes	-	-
Mesoplodon layardii	Strap-toothed beaked whale	-	-	Yes	Yes	-	-
Mesoplodon mirus	True's beaked whale	-	-	Yes	Yes	-	-
Physeter macrocephalus	Sperm whale	-	Yes	Yes	Yes	-	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Ziphius cavirostris	Cuvier's beaked whale	-	-	Yes	Yes	-	-
Dolphins							
Delphinus delphis	Common dolphin	-	-	Yes	-	-	-
Grampus griseus	Risso's dolphin	-	-	Yes	-	-	-
Lagenorhynchus obscurus	Dusky dolphin	-	Yes	Yes	-	-	-
Lissodelphis peronii	Southern right whale dolphin	-	-	Yes	Yes	-	-
Orcinus orca	Killer whale	-	Yes	Yes	-	-	-
Pseudorca crassidens	False killer whale	-	-	Yes	-	-	-
Tursiops aduncus	Indian bottlenose dolphin	-	-	Yes	Yes	-	-
Tursiops truncates s. str.	Bottlenose dolphin	-	-	Yes	-	-	-

Definitions and key as per Table 5.10.

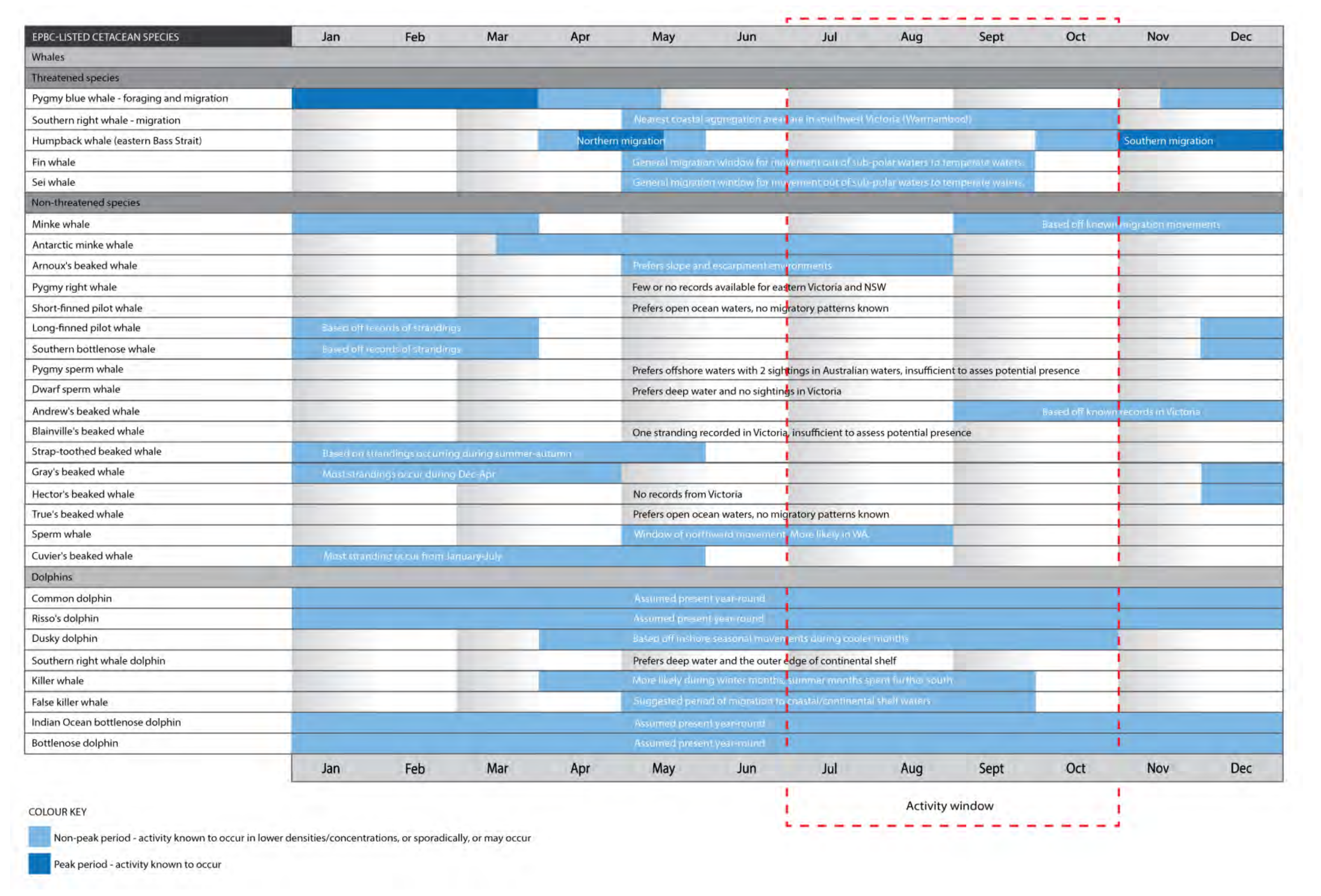


Figure 5.15. The annual presence and absence of threatened cetacean species known to migrate through the EMBA

Blue Whale

The blue whale (*Balaenoptera musculus*) is a migratory species listed as endangered under the EPBC Act 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*). Both sub-species of blue whale may be found in Australian waters and reference to blue whale unless otherwise specified is generally synonymous to both species.

The Antarctic blue whale sub-species remains severely depleted from historic whaling and its numbers are recovering slowly. For the pygmy blue whale there is uncertainty in the pre-exploitation numbers, and their current numbers are not known. The pygmy blue whale has a high-density foraging BIA within the EMBA and activity area (Figure 5.16). The blue whale has a recovery plan that identifies threats and establishes actions for assisting the recovery of blue whale populations using Australian waters (DoE, 2015d).

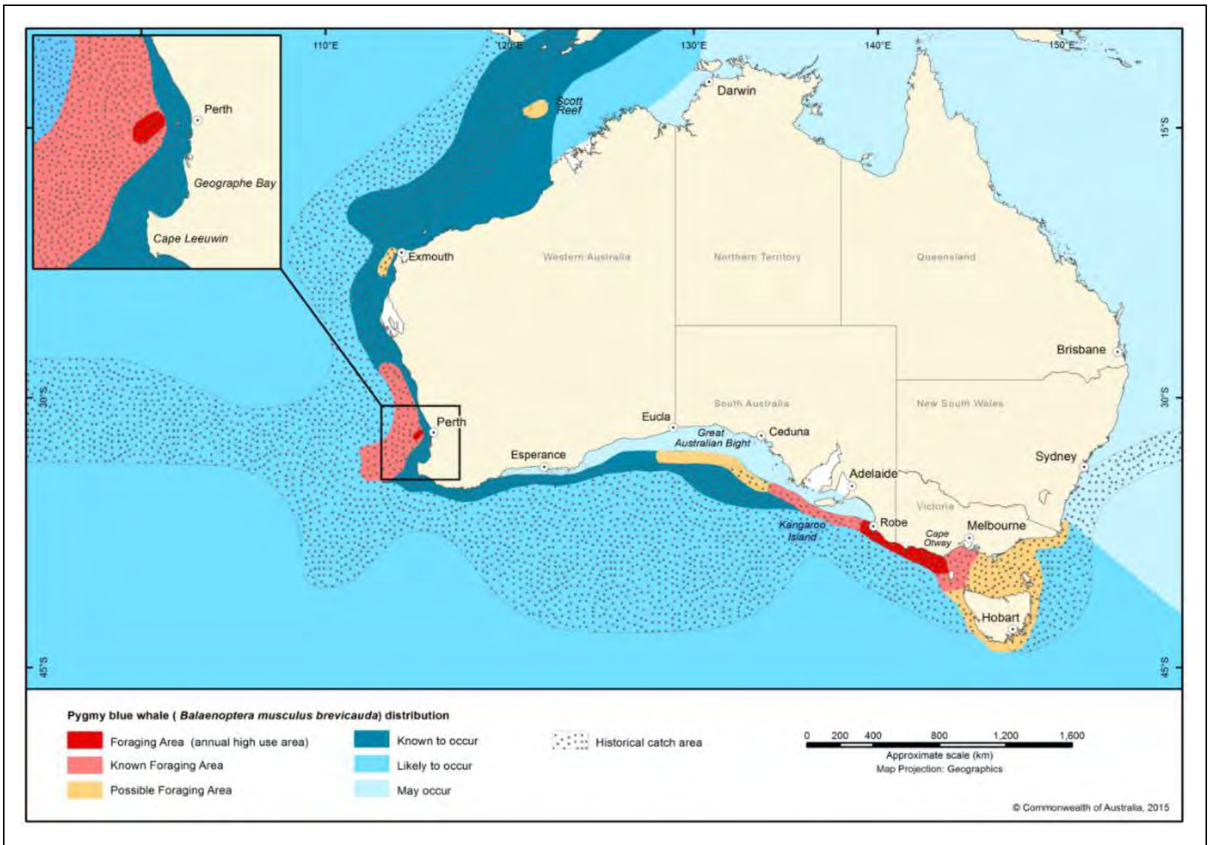


Figure 5.16: PBW distribution around Australia

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

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.

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

Important foraging grounds for blue whales include the Great Australian Bight, South Australia and off Portland Victoria where blue whales visit between November and May to forage on the inshore shelf break. 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).

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

Gill et al (2011) undertook 69 seasonal aerial surveys for blue whales between Cape Jaffa and Cape Otway over six seasons (2001-02 to 2006-07). This study found that the general pattern of seasonal movement of blue whales is from west to east, with whales foraging in between the Great Australian Bight and Cape Nelson in November and spreading further east in December. Whales are typically widely distributed throughout Otway shelf waters from January through to April (Gill *et al*., 2011) (Figure 5.17).

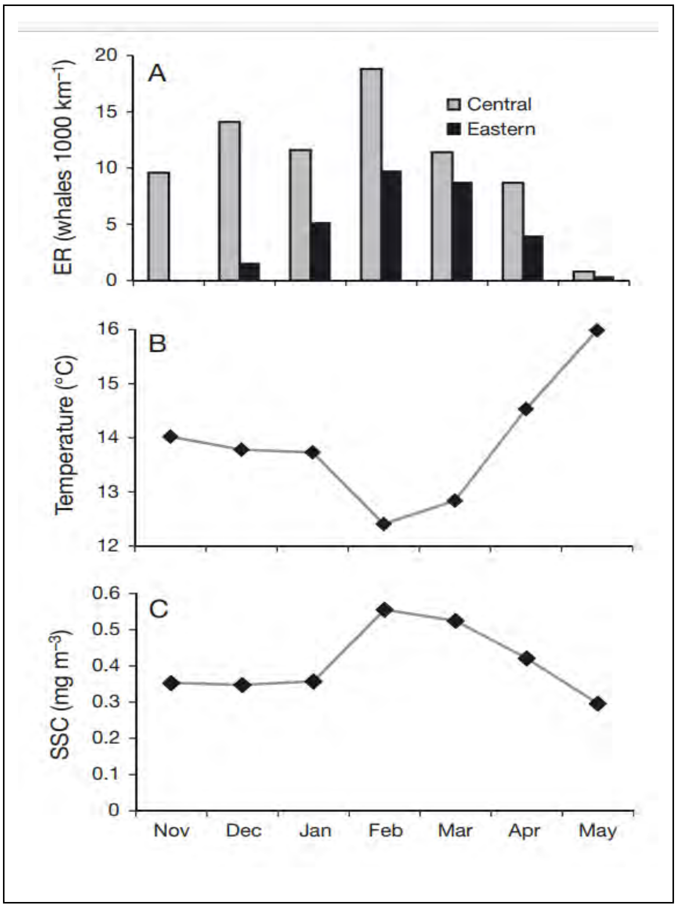


Figure 5.17: Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month (Gill *et al*., 2011)

Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month is shown in Figure 5.17 with sighting and effort data presented geographically in Figure 5.18. Data is pooled for all seasons, for central and eastern areas, overlaid on gridded aerial survey effort (10 km x 10 km squares), represented as minutes flown per grid square (key, upper right). Thick solid lines represent 50% and 95% probability contours for blue whale distribution from density kernel analysis. Dashed lines are central and eastern boundaries (Gill *et al*., 2011). The EMBA is within the central and eastern areas and the activity area is on the outer edge of the eastern area.

There had been fewer than 50 sightings of blue whales in Bass Strait up to the year 1999, but since that time feeding blue whales have been more regularly observed in the Discovery Bay area and more generally along the Bonney coast from Robe to Cape Otway. Gill et al (2011) found that across the eastern zone (Cape Nelson to Cape Otway), there were no blue whale sightings in November (2001-2007) despite significant effort (Figure 5.18).

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

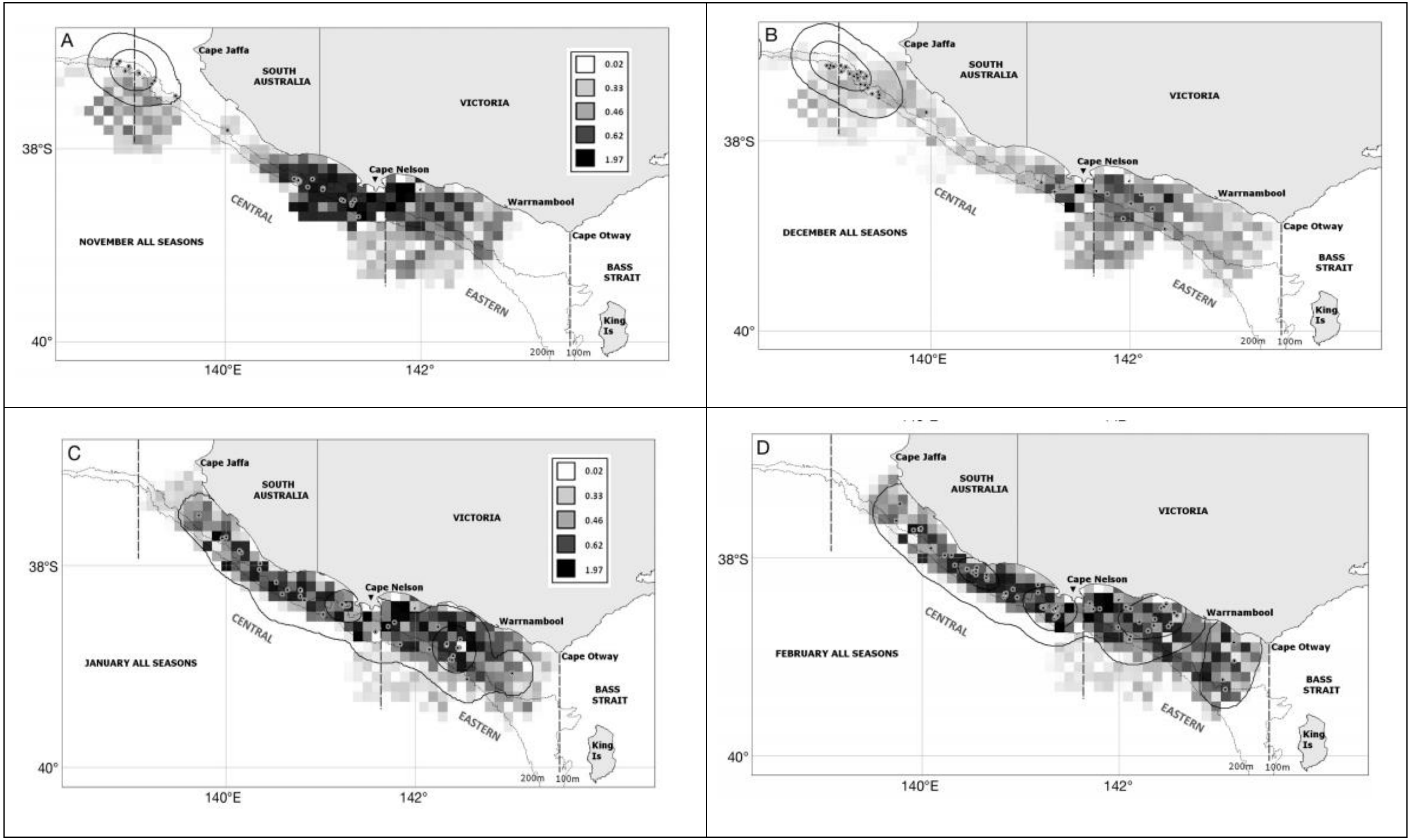


Figure 5.18. Blue whale sightings in the Otway Basin (Nov - Feb) (Gill *et al.*, 2011)

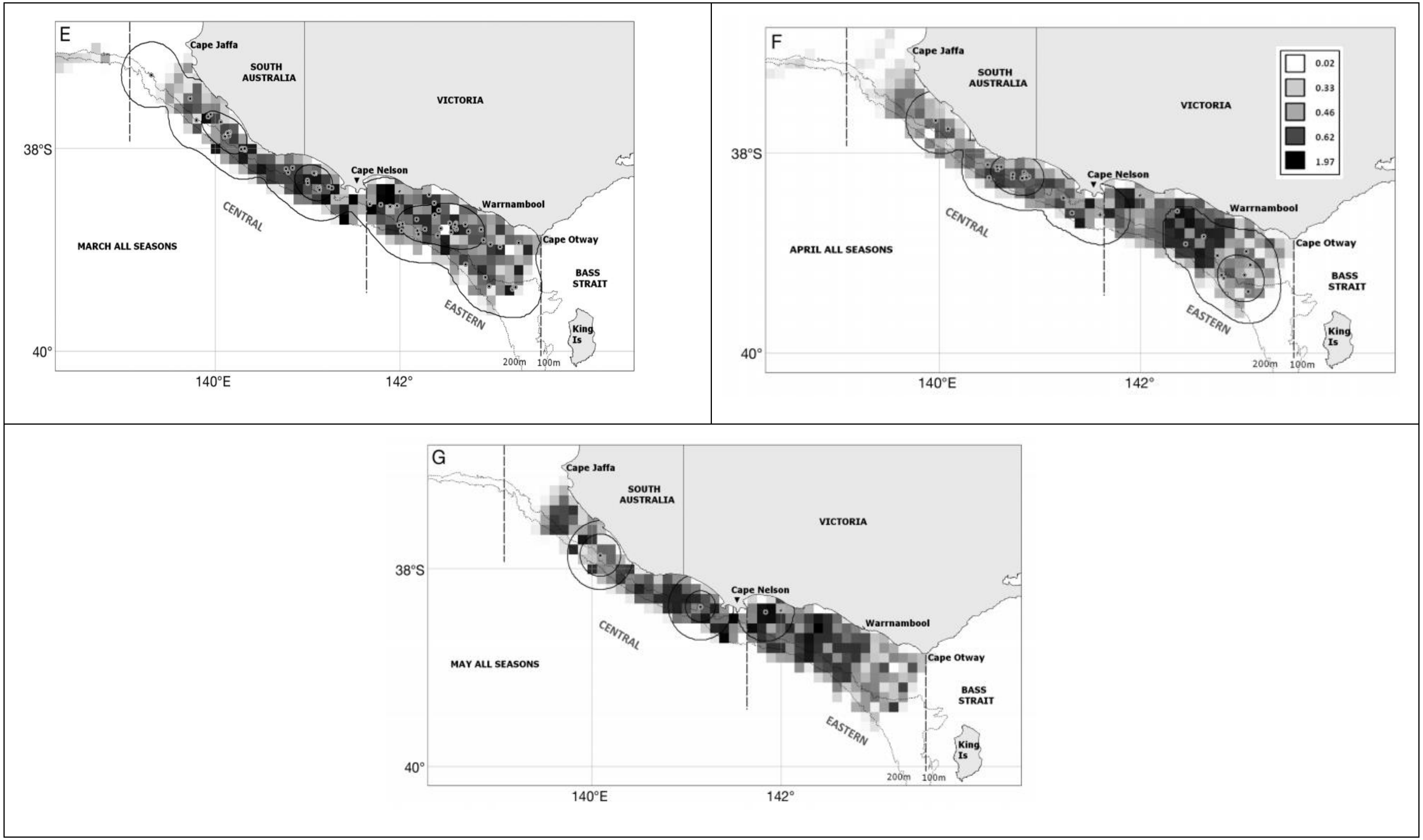


Figure 5.18 (*Con't*) Blue whale sightings in the Otway Basin (Nov - Feb) (Gill *et al.*, 2011) *Note:* Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square (key, upper right corner of the November and January figures).

The data from Gill et al (2011) shows:

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

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

Aerial surveys commissioned by Origin undertaken during 2011 and 2012 by the Blue Whale Study found that blue whales were common in the eastern upwelling zone during November-December 2012. 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. 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.

From 2009-2016 Antarctic blue whale calls were received via deep sound channel propagation south of Portland and the maximum chorus levels occurred from late February to late June with yearly increases in chorus levels (McCauley *et al.*, 2018). McCauley et al (2018) suggests that acoustic detection of Antarctic blue whales indicate they predominantly occur along the entire southern coastline.

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

- Pygmy blue whales have three migratory stages around Australia; the “southbound migration stage” were predominantly between October to December (sometimes into January) whales travel from Indonesian waters down to the WA coast, the “southern Australian stage” where between January and June whales spread across the southern Australian waters, and the “northbound migration stage” where whales travel back up to Indonesia between April and August.
- The ‘southern stage’ involves animals searching for feeding sites, feeding and then marking their way north towards June.
- Along the southern Australian coastline pygmy blue whales are most frequently detected towards the east along the Bonney coast over late February to early June, utilising secondary productivity produced by a seasonal upwelling event.

- Within a season it is difficult to predict whale numbers and their specific locations, but when correlated across seasons the strength and persistence of this upwelling event as given by time integrated water temperature south of Portland, significantly correlates with time integrated number of individual whales calling from the same site.
- The Bonney coast upwelling is a strong predicator of pygmy blue whale presence at Portland where whale presence in the area is linked to prey availability
- Sea noise data was available from the Portland site from 2009 to early 2017 detailed:
    - In 2009 and 2011 pygmy blue whales arrived in November or December whereas in the other years, calls were not detected until January or February (Figure 5.19). There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year.
    - There was considerable variability in whale persistence and presence within a season (Figure 5.19) with no consistent trend other than a peak in presence somewhere over February to June.
- It is difficult to predict numbers within a season but when correlated across seasons the strength and persistence of the Bonney coast upwelling, given by time integrated water temperature, significantly correlates with time integrated number of individual whales calling from the same site. The upwelling index explains 83% of the variability in blue whale calling presence across seasons when using seasonal whale counts (not corrected for population growth). When a growth rate of 4.3% is applied a correlation of 90% of the variance in seasonal occurrence is predicted by the upwelling index.
- The number of pygmy blue whale calling in Portland could be expected in increase yearly with whale population growth.

There were no confirmed sightings of blue whales during Origin's Speculant 3D Transition Zone 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). During the Beach Otway Development Seabed Survey (November 2019 to January 2020) there were four sightings of blue whales within 3.5 km of the Thylacine Platform in November 2019 and one sighting in January 2020 about 1 km from the Artisan well location. The whales were identified as swimming. Möller et al (2020) analysis data from the tags of 13 pygmy blue whales who were tagged in the Bonney upwelling region in January 2015 with tags transmitting up to March 2016. In summary:

- 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 (Figure 5.20).
- 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.

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

There are two known seasonal feeding aggregations areas in Australia, the Bonney Coast Upwelling KEF and adjacent waters off South Australia and Victoria and the Perth Canyon KEF and adjacent waters in Western Australia (Figure 5.16). The abundance of pygmy blue whales varies within and between seasons, but they typically forage in the Otway region between January and April. Foraging of pygmy blue whales is known to occur in Bass Strait and the west coast of Tasmania where they have been recorded diving at depth presumably feeding (DoE, 2015d). 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-April) (McCauley *et al*., 2018). The two pygmy blue whale call types and the Antarctic blue whale call have been detected in central Bass Strait. One occasion all three types were detected between April and June with more commonly two calls present over this period during other years.

Passive acoustic monitoring in southern Australia during 2000-2017 focused on the distribution and population parameters of both subspecies of blue whales in southern and western Australia. In Portland sea noise data was available from 2009 to early 2017. In 2009 and 2011 pygmy blue whales arrived in November or December whereas in the other years, calls were not detected until January or February. There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year. Acoustic loggers located east of the Thylacine platform from February to October 2011 detected pygmy blue whales between February and early June, with the greatest abundance from March to mid-May.

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

BIAs for pygmy blue whales have been identified around Australia with the foraging BIA intersecting the activity area and EMBA (Figure 5.21). Encounters with blue whales and the installation activities is considered unlikely due to the timing of the activity (August-September). Survey data suggests that blue whales are most likely to first appear during December/January and reach peak number during February/March. The likelihood and extent of the interaction is dependent on broad scale environmental factors affecting the abundance and distribution of blue whale feeding resources. Given the information presented above, interactions between blue whales and the activity are unlikely as the activity will be conducted outside of peak foraging periods.

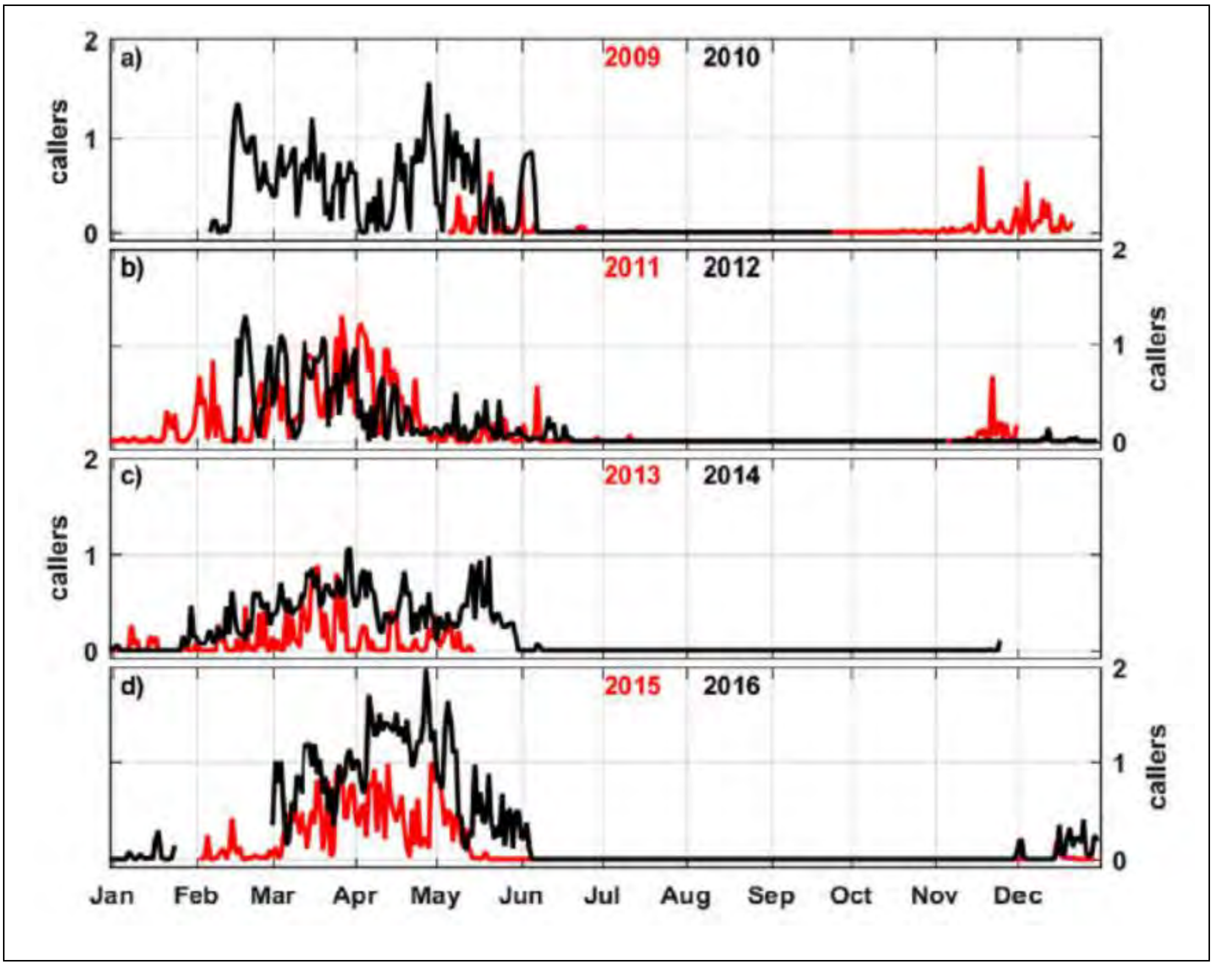


Figure 5.19: Mean number of individual pygmy blue whales calling (McCauley *et al.*, 2018)

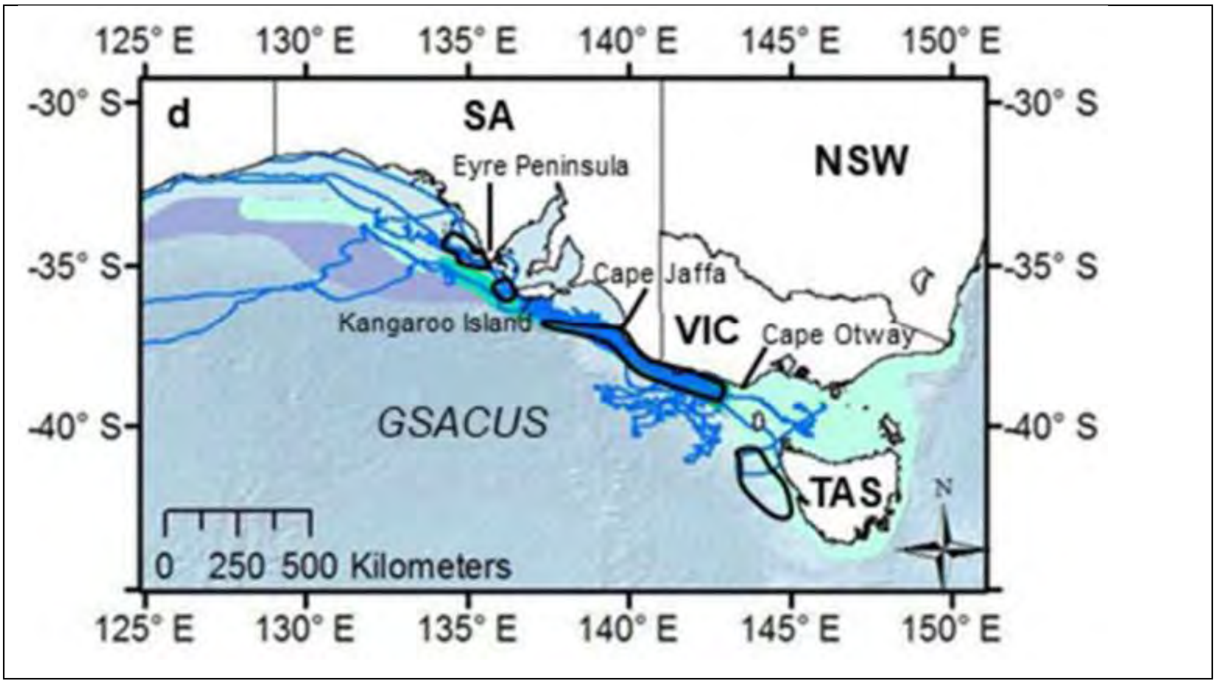


Figure 5.20: Tracks of 13 pygmy blue whales in the Great Southern Australian Coastal Upwelling System (GSACUS) (Möller et al., 2020)

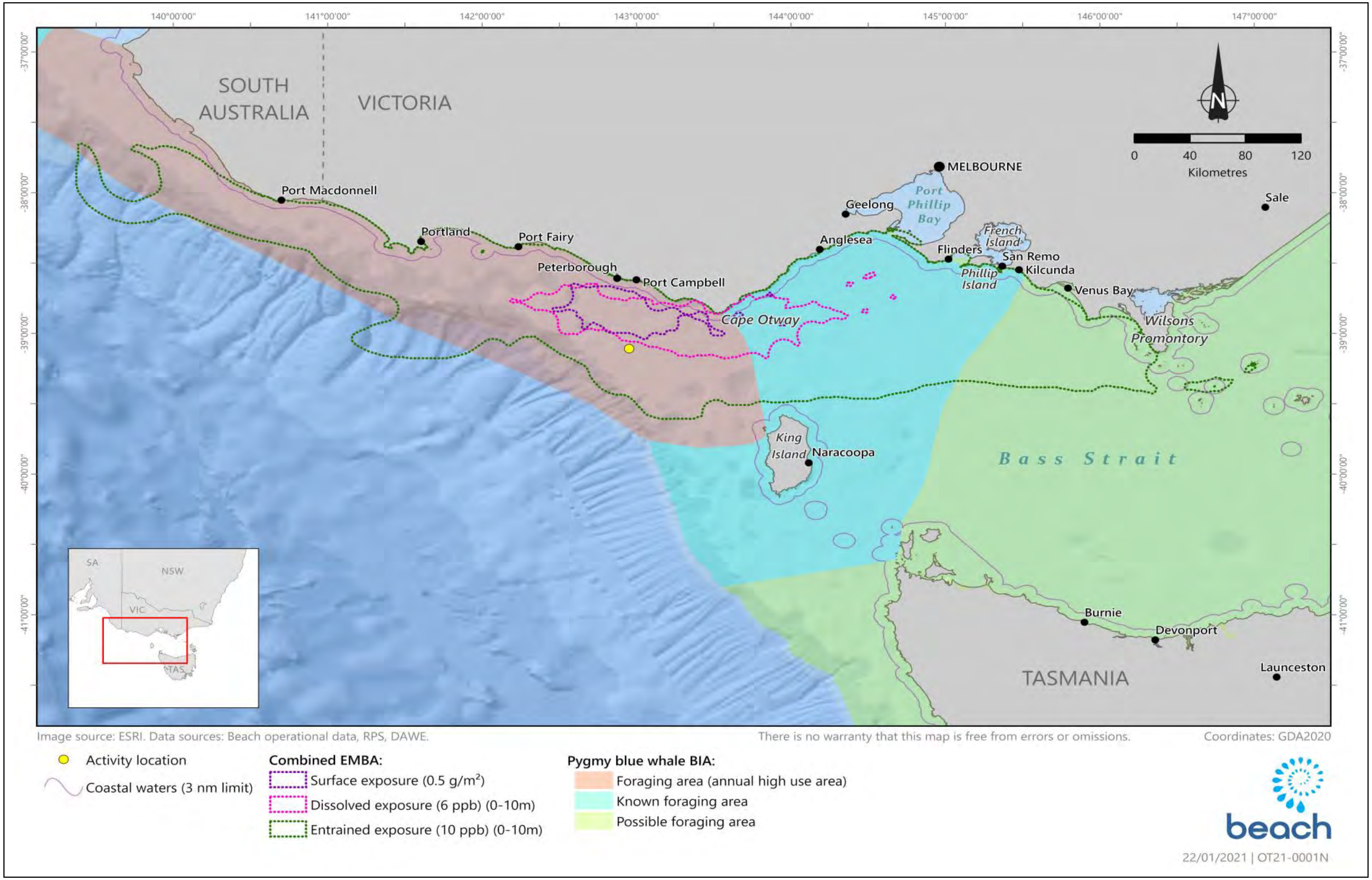


Figure 5.21. Pygmy blue whale BIA with activity area and EMBA

Southern Right Whale

Southern right whales (SRW) (*Eubalaena australis*) 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 5.22) Aggregation areas for SRW (DSEWPaC, 2012a). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (DSEWPaC, 2012a). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (DSEWPaC, 2012a).

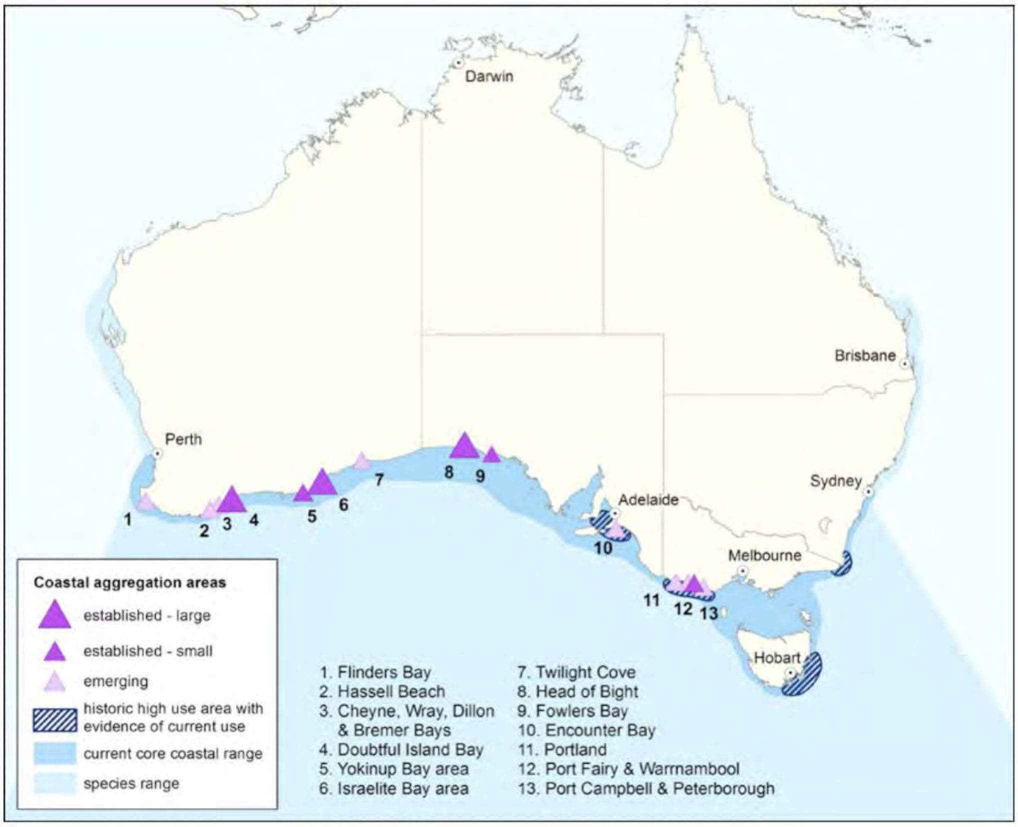
The SRW is listed as endangered under the EPBC Act in Australia and as critically endangered on the Victorian Threatened Species Advisory List. SRW were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov *et al*., 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because SRW have a slow rate of increase (7% per annum (p.a.)) compared to other marine mammals, their numbers remain low (Stamation *et al*, 2020). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia and New Zealand.

The Australian population of SRW is divided into two sub-populations due to genetic diversity (Carroll *et al*., 2011) and different rates of increase (DSEWPaC, 2012a). The western subpopulation 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. 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).

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, Fowlers Bay in SA and the Warrnambool and Portland in Victoria (Figure 5.22). Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA (DSEWPaC, 2012a). SRW generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton, 2017). 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).

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). The spill EMBA overlaps the SRW (*Eubalaena australis*) aggregation, connecting habitat, migration and current core coastal range (Figure 5.23).

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).



Source: DSEWPC (2012b)

Figure 5.22. SRW aggregation areas

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). A defined near-shore coastal migration corridor is unlikely given the absence of any predictable directional movement of SRW such as that observed for humpback whales. A predominance of westward movements amongst long-range photo-identification re-sightings may indicate a seasonal westward movement in coastal habitat (Burnell, 2001). Direct approaches and departures to the coast have also been recorded through satellite telemetry studies (Mackay *et al*., 2015).

Aerial surveys of western Bass Strait and eastern Great Australian Bight undertaken by Gill et al, (2015) detected 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. 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 conservation management plan for the SRW (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. Given the activity timing of August-September, it is possible that SRW will migrate through, or in proximity to, the activity area. However, the activity area is not located within a coastal aggregation site.

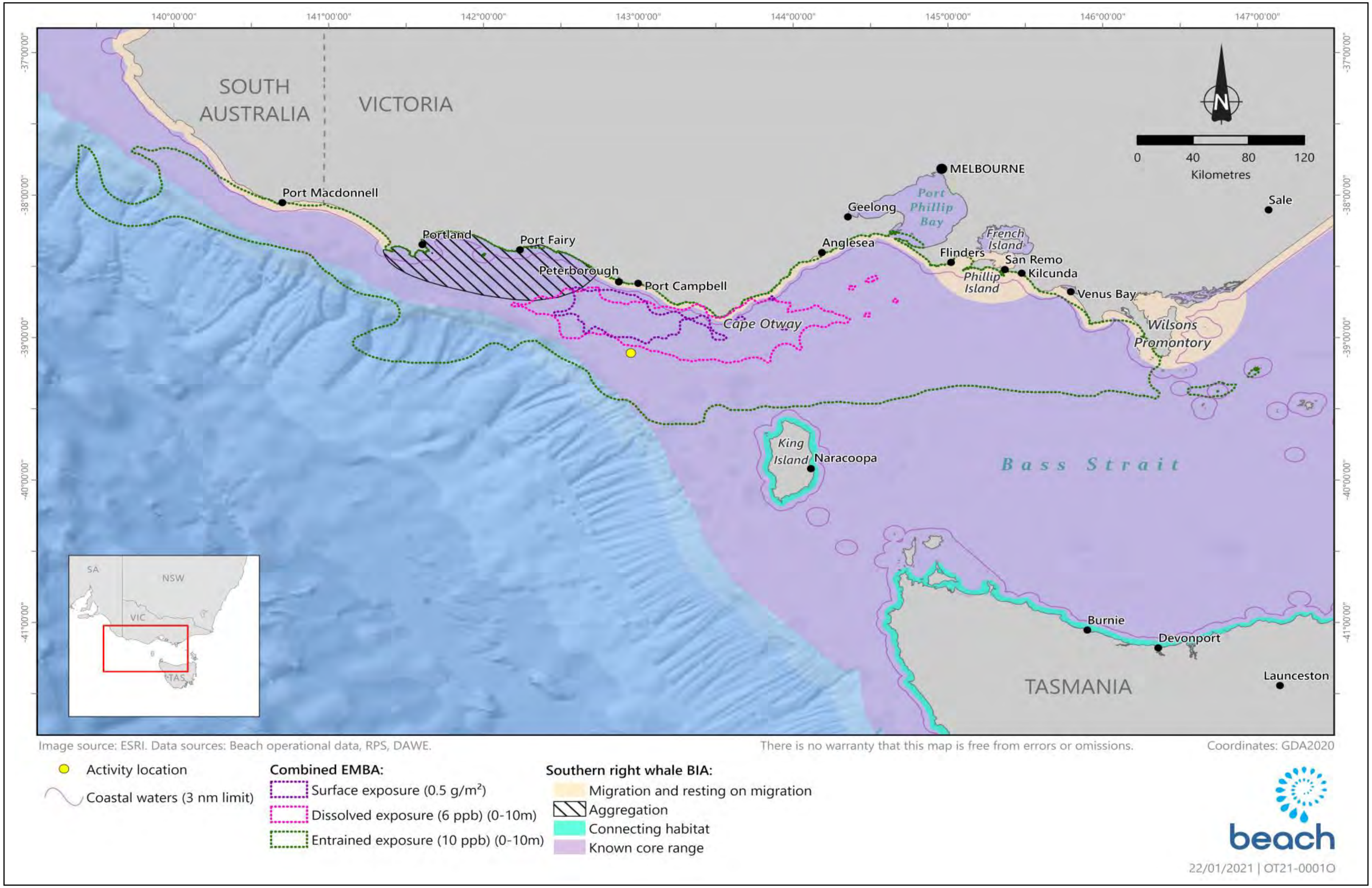


Figure 5.23. SRW BIA intersected by the activity area and spill EMBA

Humpback Whale

The humpback whale (*Megaptera novaeangliae*) is a moderately large (15-18 m long) baleen whale that has a worldwide distribution and a geographic segregation. In the 19th and 20th centuries, humpback whales were hunted extensively throughout the world's oceans and as a result it is estimated that 95% of the population was eliminated. Commercial whaling of humpback whales ceased in 1963 in Australia, at which time it is estimated that humpback whales were reduced to between 3.5 and 5% of pre-whaling abundance (TSSC, 2015b). The EPBC Act Threatened Species Scientific Committee (TSSC) states that a 2012 and 2014 review of the conservation status of the species considered that it no longer meets any criteria for listing as threatened under the EPBC Act though it remains listed as vulnerable (TSSC, 2015b).

Humpback whales are found in Australian offshore and Antarctic waters. They primarily feed on krill in Antarctic waters south of 55°S. The eastern Australian population of humpback whales is referred to as Group E1 by the International Whaling Commission, one of seven distinct breeding stocks in the southern hemisphere (TSSC, 2015b). Bass Strait represents part of the core range of the E1 Group. Feeding, resting or calving is not known to occur in Bass Strait (TSSC, 2015b) though migration through Bass Strait occurs (Figure 5.24). The nearest area that humpback whales are known to congregate and potentially forage is at the southern-most part of NSW near the eastern border of Victoria approximately 550 km northeast of the activity area (Figure 5.24) at Twofold Bay, Eden off the New South Wales south coast.

Humpback whales migrate from their summer feeding grounds in Antarctic waters northward up the Australian east coast to their breeding and calving grounds in sub-tropical and tropical inshore waters (TSSC, 2015b). The northern migration off the southeast coast starts in April and May with the southern migration occurring from November to December. This migration tends to occur close to the coast along the continental shelf boundary in waters about 200 m deep (TSSC, 2015b) (Figure 5.25). The conservation advice for the humpback whale (TSSC, 2015b) identifies vessel strike and anthropogenic noise as threats to the species. The spill EMBA overlaps the core migration range of humpback whales. It is likely that humpback whales migrate through the eastern extent of the spill EMBA during April, May, November and December. Therefore, given the activity timing of August-September, humpback whales are unlikely to be present in the activity area or EMBA during this time.

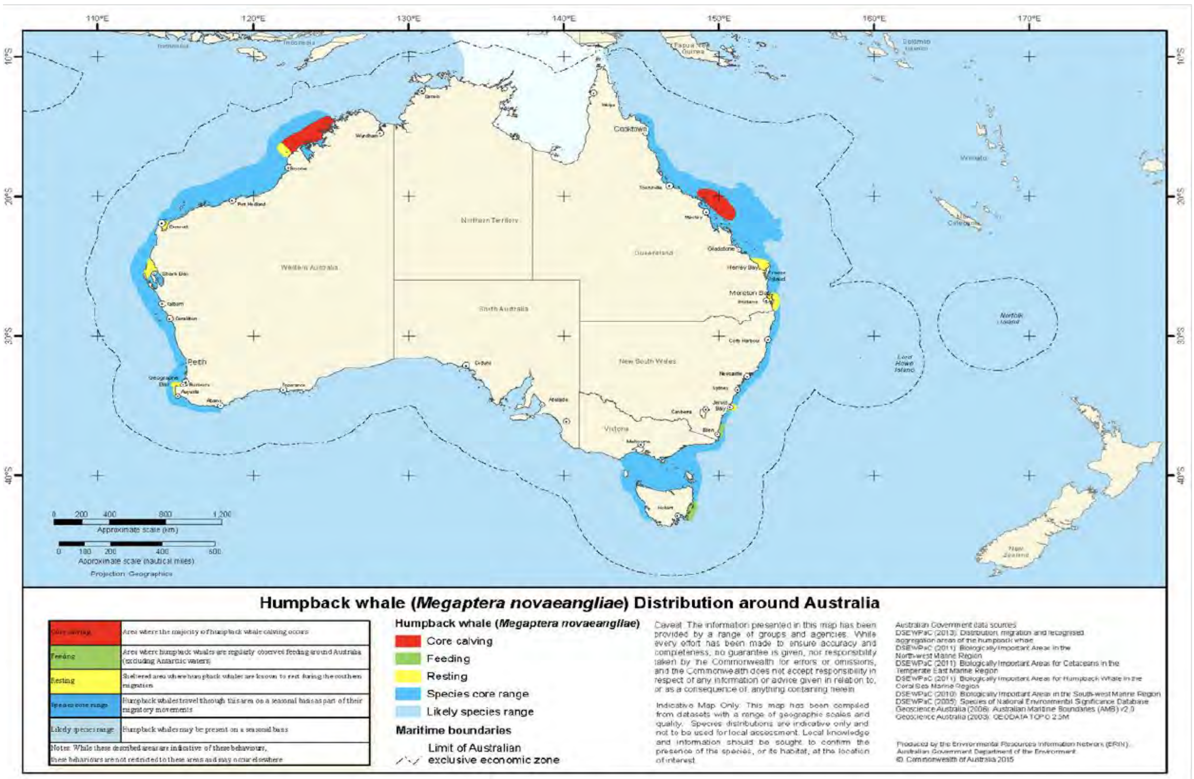


Figure 5.24. Humpback whale distribution around Australia

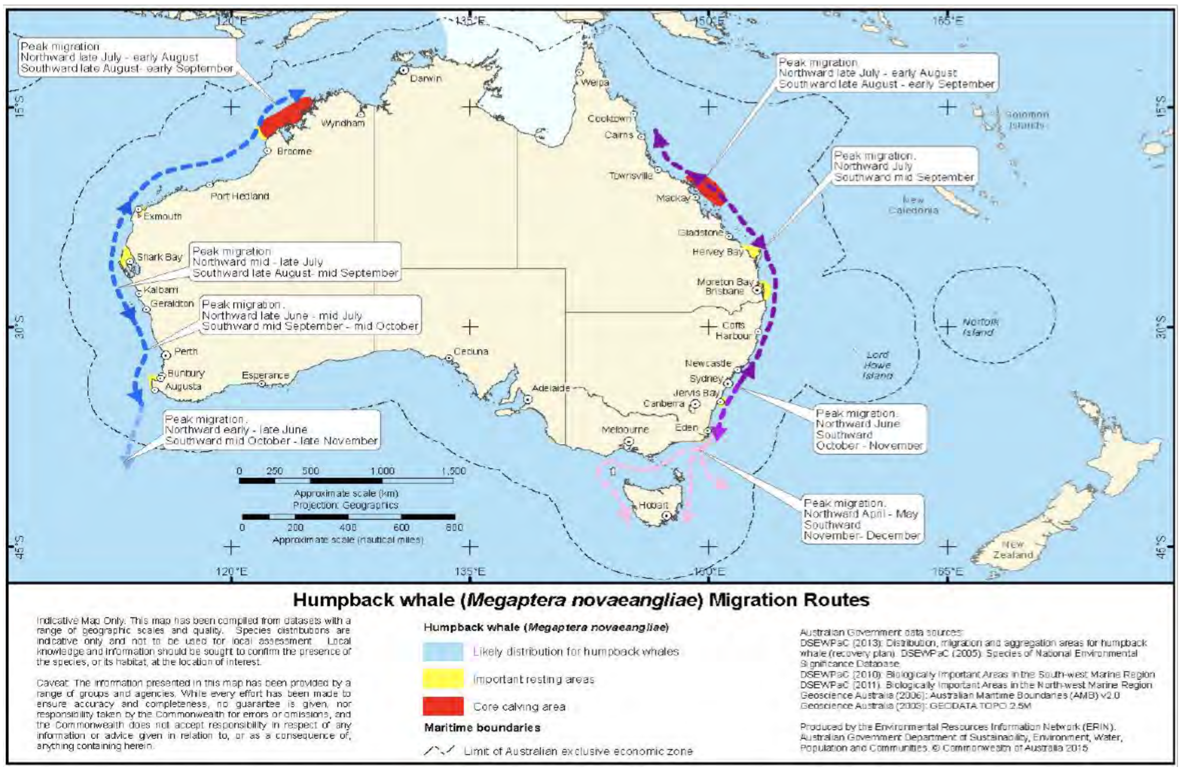


Figure 5.25. Humpback whale migration routes around Australia

Fin Whale

Fin whales (*Balaenoptera physalus*) 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 EMBA, they are likely to be uncommon visitors to the activity area and EMBA.

Sei Whale

Sei whales (*Balaenoptera borealis*) 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 (Bannister *et al*., 1996; 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 and EMBA and more likely during upwelling conditions.

Dusky Dolphin

The dusky dolphin (*Lagenorhynchus obscurus*) 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 (Gill *et al*., 2000; Ross, 2006).

Only 13 reports of the dusky dolphin have been made in Australia since 1828 (the very first described specimen of the species by French naturalists was from off the coast of Tasmania in 1826 and key locations are yet to be identified (Bannister *et al*., 1996).

The dusky dolphin occurs across southern Australia from Western Australia to Tasmania and there are confirmed sightings near Kangaroo Island and off Tasmania. No key localities or critical habitats in Australian waters have been identified (Bannister *et al*., 1996).

Given the lack of sightings in Australian waters, it is unlikely that significant numbers of dusky dolphins are present in the activity area or spill EMBA.

Killer Whales

The killer whale (*Orcinus orca*) is the largest member of the dolphin family and is thought to be the most cosmopolitan of all cetaceans. It appears to be more common in cold deep waters though killer whales 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 (DAWE, 2020b).

In Victoria, sightings of killer whales peak in June/July where they have been observed feeding on sharks, sunfish and Australian fur seals (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).

It is possible that killer whales may occur in the spill EMBA, however given the distance to the nearest seal colonies is approximately 112 km from the activity area, the area around the activity area is unlikely to represent an important habitat for killer whales and significant numbers of this species are not expected in the activity area or spill EMBA.

5.4.6 Pinnipeds

There are two pinniped species recorded under the EPBC Act PMST as potentially occurring within the activity area and the spill EMBA (Table 5.13) (DAWE, 2020a). Figure 5.26 illustrates the annual activities and presence of the two pinniped species.

Table 5.13 EPBC Act-listed pinnipeds that may occur in the activity area and spill EMBA

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Arctocephalus forsteri	New Zealand fur-seal	-	-	Yes	-	-	-
Arctocephalus pusillus	Australian fur-seal	-	-	Yes	-	-	-
Neophoca cinereal	Australian sea lion	V	-	Yes		FFR	RP

Definitions and key as per Table 5.10.

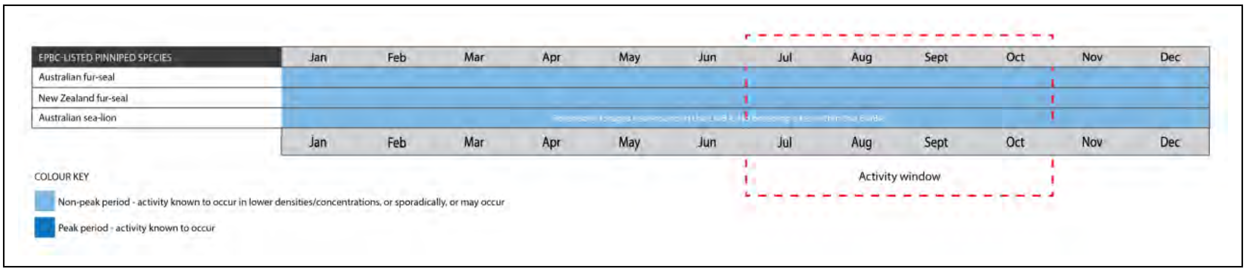


Figure 5.26. Annual activities and presence of EPBC Act-listed pinnipeds in the EMBA

<u>Australian fur-seal</u>

The Australian fur-seal (*Arctocephalus pusillus*) is common in the spill EMBA and is not listed as a threatened or migratory species under the EPBC Act.

Australian fur seals are endemic to south-eastern Australian waters and have a relatively restricted distribution around the rocky islands of Bass Strait. It is estimated that there are 60,000 Australian fur seals in Bass Strait and the waters around Tasmania. The species has been recorded in the waters off South Australia, Victoria, Tasmania and New South Wales and are the only species of seal known to breed on Victorian and Tasmanian islands in Bass Strait (Kirkwood *et al*., 2009).

There are 10 established breeding colonies of the Australian fur-seal that are restricted to islands in the Bass Strait; six occurring off the coast of Victoria and four off the coast of Tasmania (Kirkwood *et al*., 2009). The largest of the established colonies occur at Lady Julia Percy Island (26% of the breeding population and 112 km northwest of the activity area) and at Seal Rocks adjacent Phillip Island (25% of the breeding population and 197 km north of the activity area), in Victoria. Both of these locations are within the EMBA.

Australian fur-seal breeding colonies in Bass Strait and within the EMBA include:

- Kanowna Island (15,000 adults and 3,000 pups, 290 km east of the activity area); and
- Anser Group of Islands (all more than 288 km east of the activity area).

Other Australian fur-seal breeding colonies located outside the EMBA include:

- The Skerries (593 km northeast of the activity area) – 11,500 individuals and 3,000 pups (in 2002);
- Rag Island (1,000 fur seal & 270 pups in 2007, 321 km east of the activity area); and
- Judgment Rock in the Kent Island Group (~2,500 pups per year, 362 km east of the activity area) (Kirkwood *et al.*, 2009, Shaughnessy, 1999; OSRA) (Figure 5.27).

Barton et al (2012), Carlyon et al (2011) and OSRA (2015) list the haul-out sites known in Bass Strait (only the Hogan Island group is located in the EMBA):

- Beware Reef (528 km northeast of the activity area) – a haul-out site where the seals are present most of year;
- Gabo Island (632 km northeast of the activity area) – 30-50 individuals; and
- The Hogan Island group (348 km northeast of the activity area) – about 300 animals.

Australian fur seals have a relatively restricted distribution around the islands of Bass Strait where it is the most common seal (Kirkwood *et al.*, 2005). Adult tagged seals have shown travel paths from Flinders Island to King Island presumably passing through central Bass Strait. Their preferred habitat, especially for breeding, is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

During the summer months Australian fur seals are observed repeatedly travelling between northern Bass Strait islands and southern Tasmania waters following the Tasmanian east coast. 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, including off Cape Otway in western Victoria. They forage on benthos at depths of between 60 m and 80 m (Hume *et al.*, 2004; Arnould and Kirkwood, 2007; Robinson *et al.*, 2008) generally within 100 km to 200 km of the breeding colony for up to five days at a time (Hume *et al.*, 2004). The lactation period lasts for between 10 and 11 months and some females may nurse pups for up to three years (Arnould and Hindell, 2001).

Male Australian fur seals are bound to colonies during the breeding season from late October to late December. Outside the breeding season they forage up to several hundred kilometres (Hume *et al.*, 2004) and are away for long periods even up to nine days (Kirkwood *et al.*, 2005). The sexes generally forage in the same environment (Kirkwood *et al.*, 2005); this suggests that males target different prey than females as observed in similar New Zealand fur seals where males prey on larger fish and seabird species compared to females. The activity area is likely to represent foraging grounds for some Australian fur seals.

<u>Australian sea lion</u>

The Australian sea lion is the only endemic, and least abundant, pinniped that breeds in Australia (DSEWPC, 2013b). All current breeding populations are outside of the EMBAs and are located from the Abrolhos Islands (Western Australia) to the Pages Islands (South Australia). The Australian sea lion uses a variety of shoreline types but prefer the more sheltered side of islands and typically avoid rocky exposed coasts (Shaughnessy, 1999).

The spill EMBA overlaps an Australian sea lion foraging BIA (Figure 5.28). The Australian sea lion is a specialised benthic forager with its feeding occurring primarily on the sea floor (DSEWPC, 2013b). 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 (DSEWPC, 2013b). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC, 2013b) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy, 1999).

New Zealand fur-seal

New Zealand fur-seals (*A. fosteri*, also sometimes referred to as long-nosed fur-seals) are mostly found in central South Australian waters (Kangaroo Island to South Eyre Peninsula) with 77% of their population is found here (outside the EMBA) (Shaughnessy, 1999).

There are 51 known breeding sites for New Zealand fur-seals in Australia, with most of these outside of Victoria (47 in SA and WA) (Kirkwood *et al*., 2009) (see Figure 5.27). Lower density breeding areas occur in Victoria (Shaughnessy, 1999). Breeding locations in Victoria occur at Kanowna Island, off Wilson's Promontory (located 290 km northeast of the activity area) and the Skerries (located approximately 593 km northeast of the activity area) (Kirkwood *et al*., 2009) – both are located within the spill EMBA.

During the non-breeding season (November to January) the breeding sites are occupied by pups/young juveniles, whilst adult females alternate between the breeding sites and foraging at sea (Shaughnessy, 1999). New Zealand fur-seals feed on small pelagic fish, squid and seabirds, including little penguins (Shaughnessy, 1999). Juvenile seals feed primarily in oceanic waters beyond the continental shelf, lactating females feed in mid-outer shelf waters (50-100 km from the colony) and adult males forage in deeper waters.

The total Australian population of New Zealand fur seals is 58,000. The population has been slow to recover from the previous intense sealing operations from 1798 to 1820, partially as the species are slow reproducers, producing one pup per year when they reach sexual maturity at four years. Up to 15% of pups die before they reach two months of age, primarily as a result of fishing net and other marine debris entanglements.

Haul-out sites in Bass Strait, as reported by Barton et al (2012) and OSRA mapping, are listed below (only Beware Reef is outside the EMBA):

- Beware Reef (528 km northeast of the activity area);
- Kanowna Island (290 km northeast of the activity area) – about 300 individuals;
- The Hogan Islands Group (348 km northeast of the activity area); and
- West Moncoeur Island (south of Wilson's Promontory, 307 km east of the activity area).

The species prefers the rocky parts of islands with jumbled terrain and boulders and prefers smoother igneous rocks to rough limestone. Breeding colonies in Bass Strait recorded by Shaughnessy (1999) and OSRA mapping are listed below (Kanowna Island and the Anser Island group occur in the EMBA):

- Rag Island (1,000 fur seal & 235 pups in 2006, 321 km northeast of the activity area);
- Kanowna Island (10,700 adults and 2,700 pups, 290 km northeast of the activity area);
- Anser Group of Islands (all more than 289 km northeast of the activity area);
- The Skerries (593 km northeast of the activity area) – 300 individuals and 78 pups (in 2002); and
- Judgment Rock in the Kent Island Group (about 2,500 pups per year, 362 km east of the activity area) (Kirkwood *et al*., 2009)

There is no BIA for the New Zealand fur-seal in Bass Strait. Given the relatively close proximity of the activity area to breeding colonies and haul-out sites south of Wilson's Promontory, it is likely that the species feeds around the activity area, and certainly within the spill EMBA. These waters are unlikely to represent important critical feeding or breeding habitat.

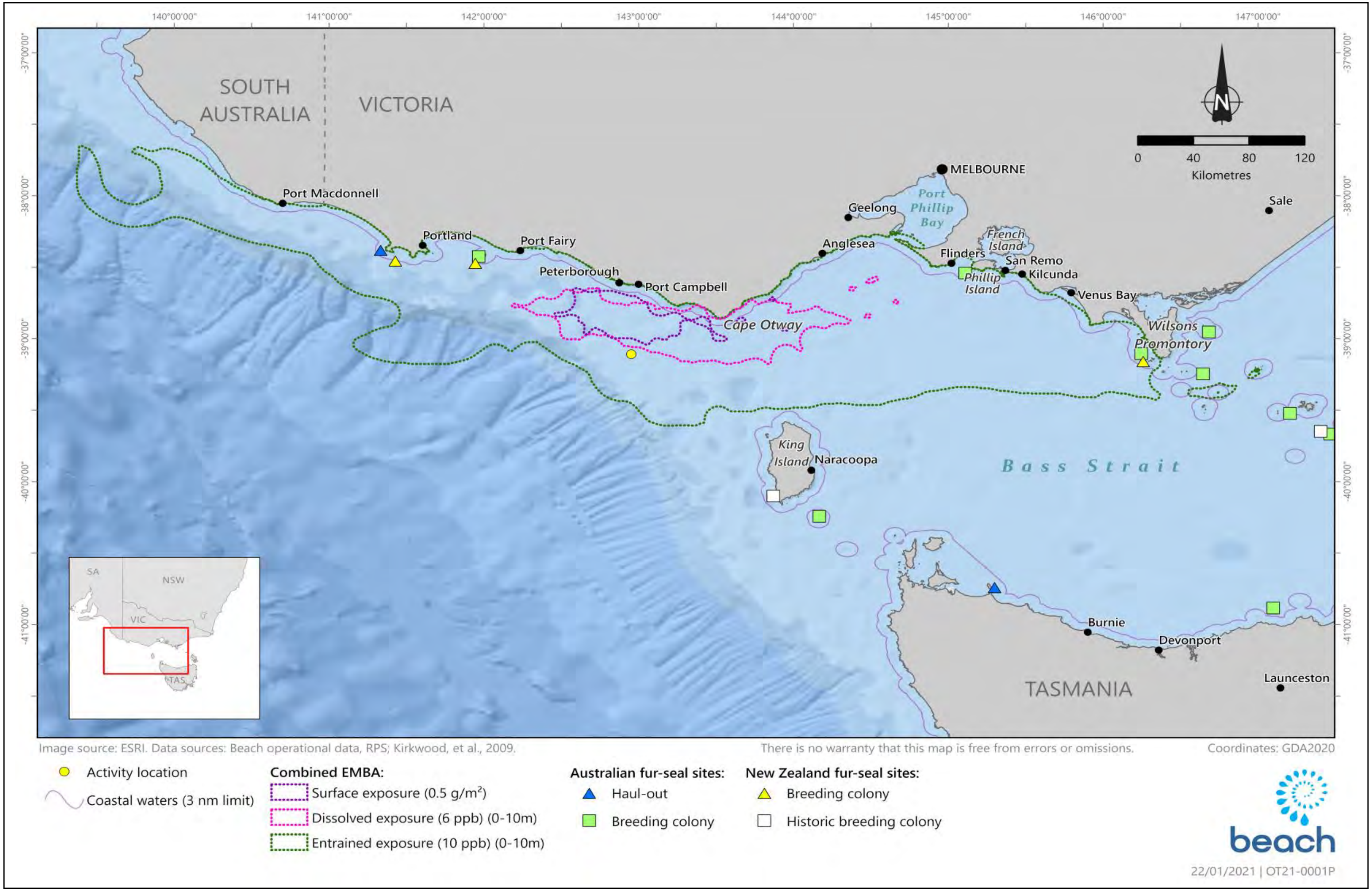


Figure 5.27. Australian and New Zealand fur-seal colonies and haul-out sites

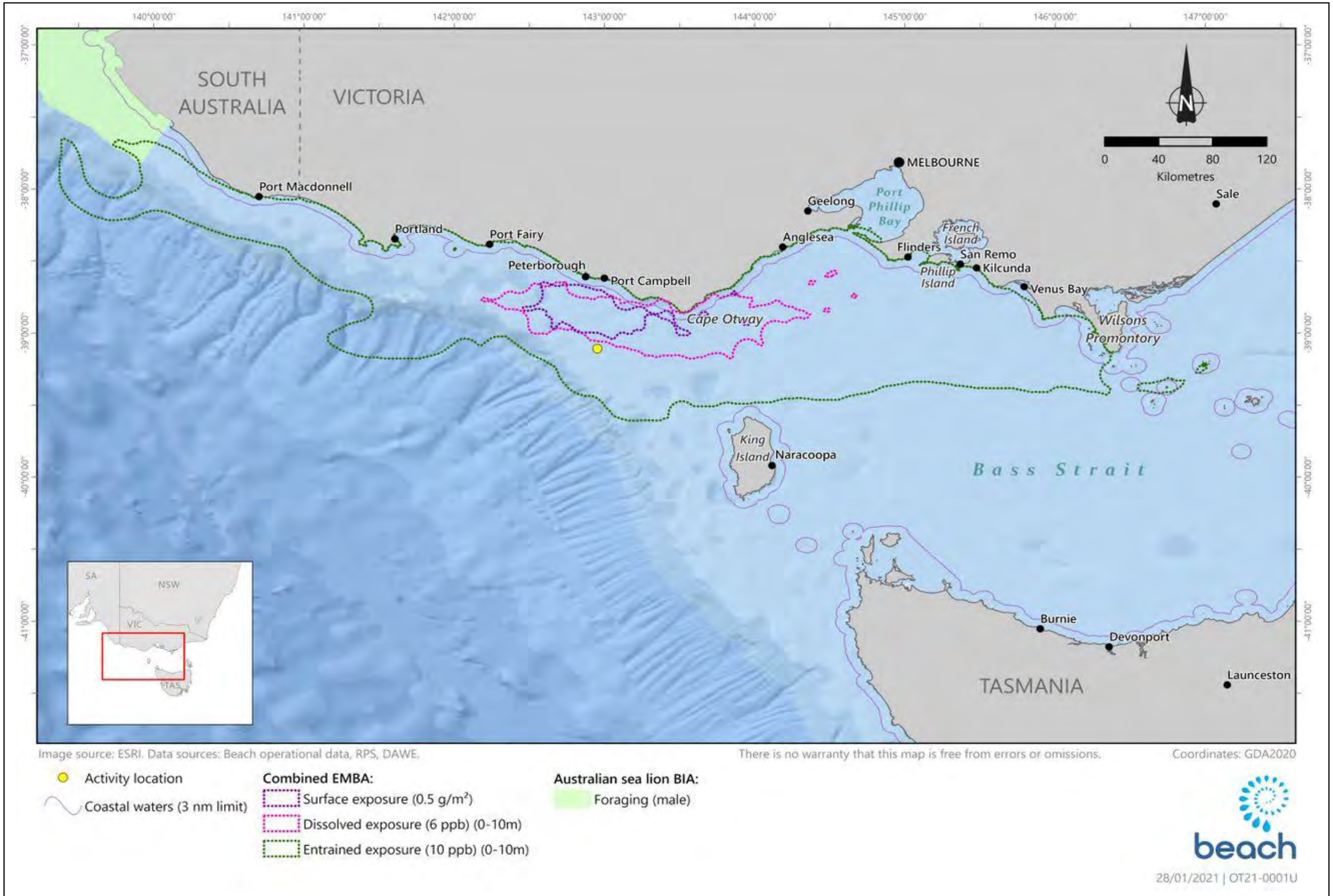


Figure 5.28. Australian sea-lion BIA intersected by the EMBA

5.4.7 Fish

It is estimated that there are over 500 species of fish found in the waters of Bass Strait, including a number of species of importance to commercial and recreational fisheries (LCC, 1993). Fish species commercially fished in and around the EMBA are listed in Section 5.7.6.

There are 36 fish species (30 of which are seahorses and pipefish) recorded in the EPBC Act PMST (DAWE, 2020a) as potentially occurring in the spill EMBA. Seven of the identified species were recorded in the PMST results for the EMBA only and were not recorded in the activity area. The threatened and migratory species are described in this section. Table 5.14 lists the fish species known or likely to occur in the EMBA.

Figure 5.29 illustrates the presence and absence of the oceanic and freshwater fish species throughout the year.

Table 5.14. EPBC Act-listed fish that may occur in the activity area and spill EMBA

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Freshwater							
Galaxiella pusilla	Eastern Dwarf Galaxia	V	-	-	Yes	-	RP
Prototroctes maraena	Australian Grayling	V	-	-	Yes	-	RP
Oceanic							
Carcharodon carcharias	Great white shark	V	Yes	-	-	FFR	RP
*Isurus oxyrinchus**	Shortfin mako	-	Yes	-	-	-	-
Lamna nasus	Porbeagle	-	Yes	-	-	-	-
Pipefish, seahorses and seadragons							
Heraldia nocturna	Eastern Upside-down Pipefish	-	-	Yes	-	-	-
Hippocampus abdominalis	Big-bellied Seahorse	-	-	Yes	-	-	-
Hippocampus breviceps	Short-head Seahorse	-	-	Yes	-	-	-
Hippocampus minotaur	Bullneck Seahorse	-	-	Yes	Yes	-	-
Histiogamphelus briggsii	Brigg's Crested Pipefish	-	-	Yes	-	-	-
Histiogamphelus cristatus	Rhino Pipefish	-	-	Yes	-	-	-
Hypselognathus rostratus	Knifesnout Pipefish	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Kaupus costatus	Deepbody Pipefish	-	-	Yes	-	-	-
Kimblaeus bassensis	Trawl Pipefish	-	-	Yes	Yes	-	-
Leptoichthys fistularius	Brushtail Pipefish	-	-	Yes	-	-	-
Lissocampus caudalis	Australian Smooth Pipefish	-	-	Yes	-	-	-
Lissocampus runa	Javelin Pipefish	-	-	Yes	-	-	-
Maroubra perserrata	Sawtooth Pipefish	-	-	Yes	-	-	-
Mitotichthys mollisoni	Mollison's Pipefish	-	-	Yes	Yes	-	-
Mitotichthys semistriatus	Halfbanded Pipefish	-	-	Yes	-	-	-
Mitotichthys tuckeri	Tucker's Pipefish	-	-	Yes	-	-	-
Notiocampus ruber	Red Pipefish	-	-	Yes	-	-	-
Physodurus eques	Leafy seadragon	-	-	Yes	-	-	-
Phyllopteryx taeniolatus	Common seadragon	-	-	Yes	-	-	-
Pugnaso curtirostris	Pugnose Pipefish	-	-	Yes	-	-	-
Solegnathus robustus	Robust Pipehorse	-	-	Yes	-	-	-
Solegnathus spinosissimus	Spiny Pipehorse	-	-	Yes	-	-	-
Stigmatopora argus	Spotted Pipefish	-	-	Yes	-	-	-
Stigmatopora nigra	Widebody Pipefish	-	-	Yes	-	-	-
Stipecampus cristatus	Ringback Pipefish	-	-	Yes	-	-	-
Urocampus carinirostris	Hairy Pipefish	-	-	Yes	-	-	-
Vanacampus margaritifer	Mother-of-pearl Pipefish	-	-	Yes	-	-	-
Vanacampus phillipi	Port Phillip Pipefish	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			Recorded in EMBA only	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Vanacampus poecilolaemus	Longsnout Pipefish	-	-	Yes	-	-	-

Definitions and key as per Table 5.10.

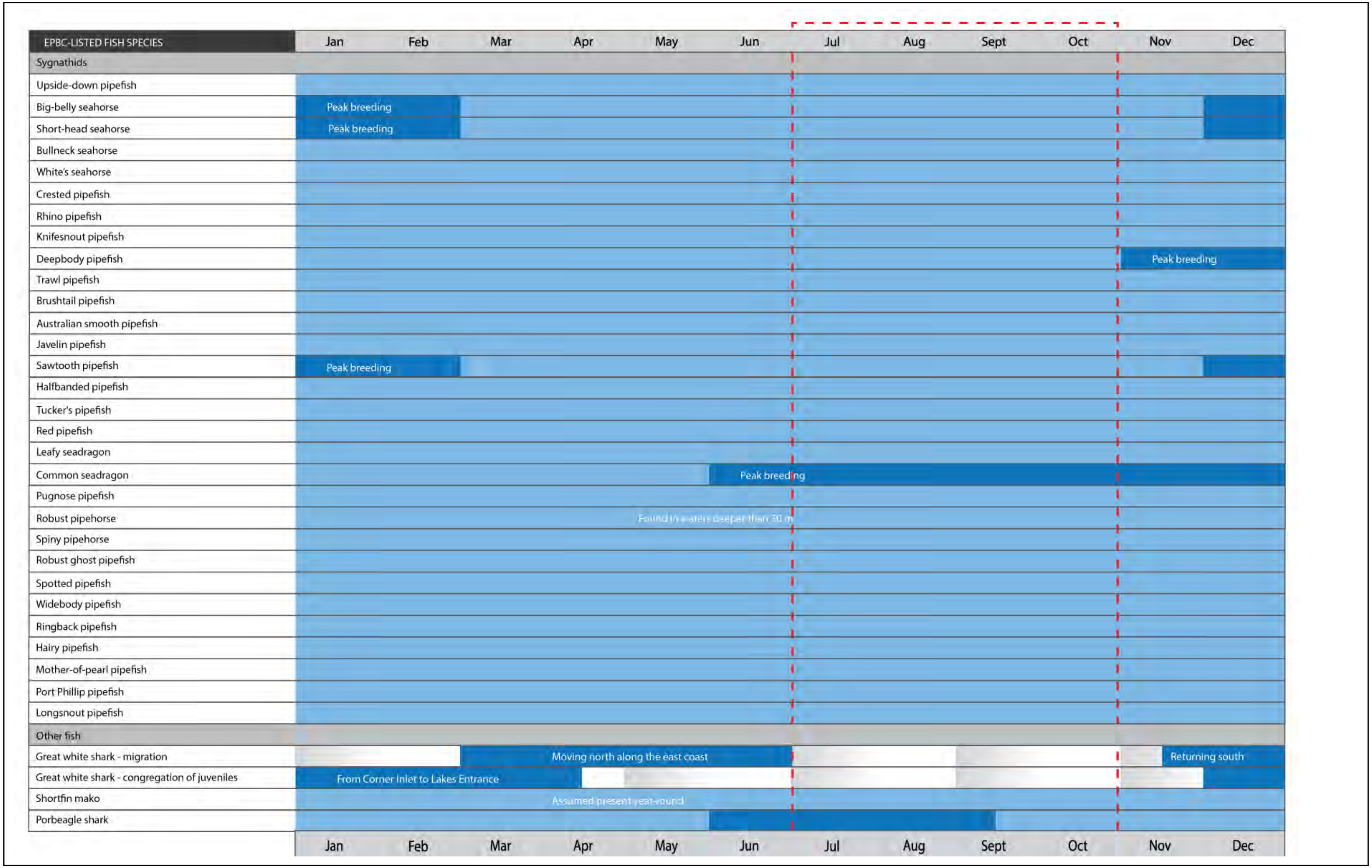


Figure 5.29. The annual presence and absence of key threatened fish species and fish species of commercial value in the spill EMBA

Eastern dwarf galaxias (EPBC Act: Vulnerable)

Habitat suitable to the eastern dwarf galaxias (*Galaxiella pusilla*) is slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often containing dense aquatic macrophytes and emergent plants (Saddlier *et al*., 2010). Given the marine nature of the activity, it is not likely that eastern dwarf galaxias' will be encountered in the spill EMBA due to its preference for freshwater habitats.

Australian grayling (EPBC Act: Vulnerable)

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 New South Wales, Victoria and Tasmania migrating between streams and the ocean (Backhouse *et al*., 2008; DELWP, 2015). The species spends most of its life in freshwater (DELWP, 2015) and migrates to lower reaches of rivers to spawn in autumn (Museums Victoria, 2020), though timing is dependent on many variables including latitude and varying temperature regimes (Backhouse *et al*., 2008), with increased stream flows also thought to initiate migration (Backhouse *et al*., 2008).

The Australian Grayling Action Statement (DELWP, 2015) lists Victorian rivers that flow into Bass Strait that are known habitat for this species and includes the Cann, Thurra and Wingan river mouths, which are intersected by the EMBA if they are open to Bass Strait. The Australian grayling is known to occur on King Island however its mapped habitat occurs on the western coast of the island which is not intersected by the EMBA. The National Recovery Plan for the Australian Grayling (Backhouse *et al*., 2008) lists the Arthur river in Tasmania as an important river for the species, which is intersected by the EMBA at its mouth. The Australian Grayling Action Statement (DELWP, 2015) list the threatening processes to this species as barriers to movement, river regulation, poor water quality, siltation, introduced fish, climate change, diseases and fishing. It is unlikely that the Australian grayling is present in the spill EMBA due to its preference for freshwater stream and river habitats though it may be present in estuarine environments during spawning.

Syngnathids (EPBC Act: Listed marine species)

There are 30 species of syngnathids (pipefish, seahorse and pipehorse) recorded in the PMST as potentially occurring in the EMBA (see Table 5.14). 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 (Museums Victoria, 2020). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as *Sargassum*.

The PMST species profile and threats profiles indicate that the sygnathiforme species listed for the EMBA are widely distributed throughout southern, south-eastern and south-western Australian waters (DAWE, 2020b). The diverse range of ecological niches afforded by the shallow waters shoreward of the EMBA would be expected to provide suitable habitat for these species. Considering the preferred depth range for these species, it is unlikely that there will be any suitable habitat in the area for these species around the activity area, but they are likely to be present within the shallow nearshore waters of the spill EMBA at all times of the year.

Great white shark (EPBC Act: Vulnerable)

The great white shark (*Carcharodon carcharias*) is widely distributed and located throughout temperate and sub-tropical waters. The known range in Australian waters includes all coastal areas except the Northern Territory (DSEWPC, 2013c) (Figure 5.30).

Studies indicate that the great white shark is usually a solitary animal, largely transient in areas it inhabits for days to weeks (DSEWPC, 2013c). Individuals are known to return to feeding grounds on a seasonal basis (Klimley and Anderson, 1996). The species moves seasonally along the south and east Australian coasts, moving northerly along the coast during autumn and winter and returning to southern Australian waters by early summer. Observations of adult great white sharks in or near the spill EMBA area are more frequent around Australian fur-seal colonies (see Figure 5.27) including Wilsons Promontory and Seal Rocks, Phillip Island. Juveniles are known to congregate along Ninety Mile Beach from Corner Inlet to Lakes Entrance. Museums Victoria (2020) indicates that Corner Inlet may be an important nursery area for the eastern population of great white sharks mostly from mid-summer through to autumn (DSEWPC, 2013c).

Key threats to the species as listed in the White Shark Recovery Plan (DSEWPC, 2013c) are mortality from targeted fishing, accidental fishing bycatch and illegal fishing and mortality from shark control activities such as beach meshing and drum-lining. Given the transitory nature of the great white shark and the separation of the spill EMBA from known great white shark breeding and foraging areas, it is likely that great white sharks will be present in the spill EMBA area only in a transitory manner.

Shortfin mako shark (EPBC Act: Listed migratory)

The shortfin mako shark (*Isurus oxyrinchus*) is a pelagic species with a circum-global wide-ranging 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 (Museums Victoria, 2020). Populations of the shortfin mako shark are considered to have undergone a substantial decline globally. These sharks are common by-catch species of commercial fisheries (Mollet *et al*., 2000).

Due to their widespread distribution in Australian waters, shortfin mako sharks may be present in the spill EMBA at all times of the year.

Porbeagle shark (EPBC Act: Listed migratory)

The porbeagle shark (*Lamna nasus*) is widespread in the southern waters of Australia (Museums Victoria, 2020). 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 and makes 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).

Due to their widespread distribution in Australian waters, porbeagle sharks may be present in the spill EMBA at all times of the year.

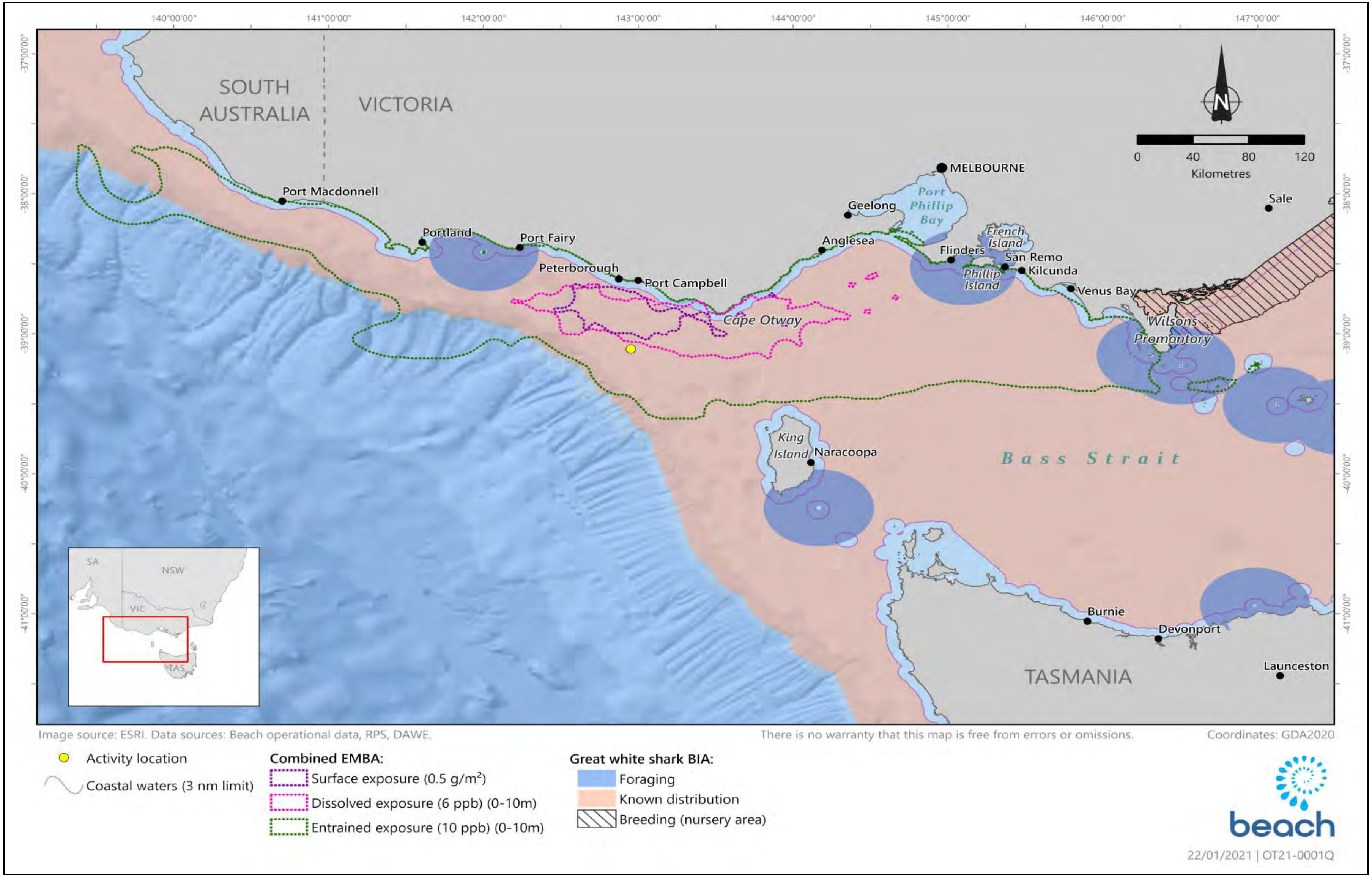


Figure 5.30. Great white shark BIA intersected by the activity area and EMBA

5.4.8 Turtles

Three species of marine turtle are listed under the EPBC Act as potentially occurring in the activity area and spill EMBA, as listed in Table 5.15. No BIAs for turtles occur within the activity area or the EMBA.

Table 5.15. EPBC Act-listed reptiles that may occur in the activity area and spill EMBA

Scientific name	**Common name**	**EPBC Act Status**			**Recorded in EMBA only**	**BIA within the EMBA?**	**Recovery Plan in place?**
		Listed threatened species	**Listed migratory species**	**Listed marine species**			
Caretta caretta	Loggerhead turtle	E	Yes	Yes	-	-	Generic RP in place for all marine turtle species, +
Chelonia mydas	Green turtle	V	Yes	Yes	-	-	
Dermochelys coriacea	Leatherback turtle	E	Yes	Yes	-	-	

Definitions and key as per Table 5.10.

<u>Loggerhead turtle (EPBC Act: Endangered, listed migratory)</u>

The loggerhead turtle (*Caretta caretta*) is globally distributed in sub-tropical waters (Limpus, 2008a) including eastern, northern and western Australia (DoEE, 2017a), and is rarely sighted off the Victorian coast.

The main Australian breeding areas for loggerhead turtles are generally confined to southern Queensland and Western Australia (Cogger *et al*., 1993). Loggerhead turtles will migrate over distances in excess of 1,000 km and show a strong fidelity to their feeding and breeding areas (Limpus, 2008a). Loggerhead turtles are carnivorous, feeding primarily on benthic invertebrates such as molluscs and crabs in depths ranging from nearshore to 55 m in tidal and sub-tidal habitats, reefs, seagrass beds and bays (DoEE, 2017a).

No known loggerhead foraging areas have been identified in Victoria waters (DoEE, 2017a). As such, it is unlikely to occur within the spill EMBA.

<u>Green turtle (EPBC Act: Vulnerable, listed migratory)</u>

The green turtle (*Chelonia mydas*) is distributed in sub-tropical and tropical waters around the world (Limpus, 2008b; DoEE, 2017a). In Australia, they nest, forage and migrate across tropical northern Australia. Mature turtles settle in tidal and sub-tidal habitat such as reefs, bays and seagrass beds where they feed on seagrass and algae (Limpus, 2008b; DoEE, 2017a).

There are no known nesting or foraging grounds for green turtles in Victoria and they occur only as rare vagrants (DoEE, 2017a). The DoEE (2017a) maps the green turtle as having a 'known' or 'likely' range within Bass Strait and as such, there is a low probability that this species may be encountered in the spill EMBA.

<u>Leatherback turtle (EPBC Act: Endangered, listed migratory)</u>

The leatherback turtle (*Dermochelys coriacea*) is widely distributed throughout tropical, sub-tropical and temperate waters of Australia (DoEE, 2017a) including oceanic waters and continental shelf waters along the coast of southern Australia (Limpus, 2009). Unlike other marine turtles the leatherback turtle utilises cold water foraging areas with reported foraging along the coastal waters of central Australia (southern Queensland to central New South Wales), southeast Australia (Tasmania, Victoria and eastern South Australia) and southern Western Australia (Limpus, 2009). This species feeds on soft-bodied invertebrates including jellyfish (Limpus, 2009).

No major nesting has been recorded in Australia, with isolated nesting recorded in the Northern Territory, Queensland and northern New South Wales (DoEE, 2017a). This species nests only in the tropics. The DoEE (2017a) maps the leatherback turtles as having a known or likely range within Bass Strait and a migration pathway in southern waters. The activity area and spill EMBA is not a critical habitat for the species; it may occur in low numbers during migration.

5.4.9 Invasive Marine 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. Though the exact port of mobilisation for the activity is not yet known, invasive species recorded in the most likely ports are presented below.

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, 2021) 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.

5.5 Conservation Values and Sensitivities

The conservation values and sensitivities in and around the activity area and within the spill EMBA are described in this section, with Table 5.16 providing an outline of the conservation categories included.

Table 5.16. Conservation values in the EMBA

Category	Conservation classification	EP Section
MNES	Commonwealth marine areas (principally AMPs)	5.5.1
	World Heritage-listed properties	5.5.2
	National Heritage-listed places	5.5.3
	Wetlands of International Importance	5.5.4
	Nationally threatened species and threatened ecological communities	Throughout Sections 5.4 and 5.5.6.
	Migratory species	Throughout Section 5.4
	Great Barrier Reef Marine Park	Not applicable
	Nuclear actions	Not applicable
	A water resource, in relation to coal seam gas development and large coal mining development	Not applicable
Other areas of national importance	Commonwealth heritage-listed places	5.5.5
	Key Ecological Features (KEFs)	5.5.7
	Nationally important wetlands (NIWs)	5.5.8
Victorian protected areas	MNPs, marine parks and sanctuaries	5.5.9
	Coastal (onshore) conservation reserves	5.5.9
Tasmanian protected areas	MNPs, marine parks and sanctuaries	5.5.10
	Coastal (onshore) conservation reserves	5.5.10

5.5.1 Australian Marine Parks

The South-east Marine Parks 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 South East Marine Region (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.

There are no Australian Marine Parks (AMPs) that are intersected by the activity area. Two AMPs occur within the EMBA and are presented in Figure 5.31. These are:

- Apollo AMP; and
- Beagle AMP;

The South-east Marine Reserves are managed under the South-east Marine Reserves Management Plan (DNP, 2013) and those intersected by the EMBA are described below.

Apollo

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

The major conservation values of the Apollo AMP are:

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

Beagle

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

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

The major conservation values of the Beagle AMP are:

- Ecosystems, habitats and communities associated with the Southeast Shelf Transition and associated with the seafloor features: basin, plateau, shelf and sill.
- Important migration and resting areas for SRW.
- 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).

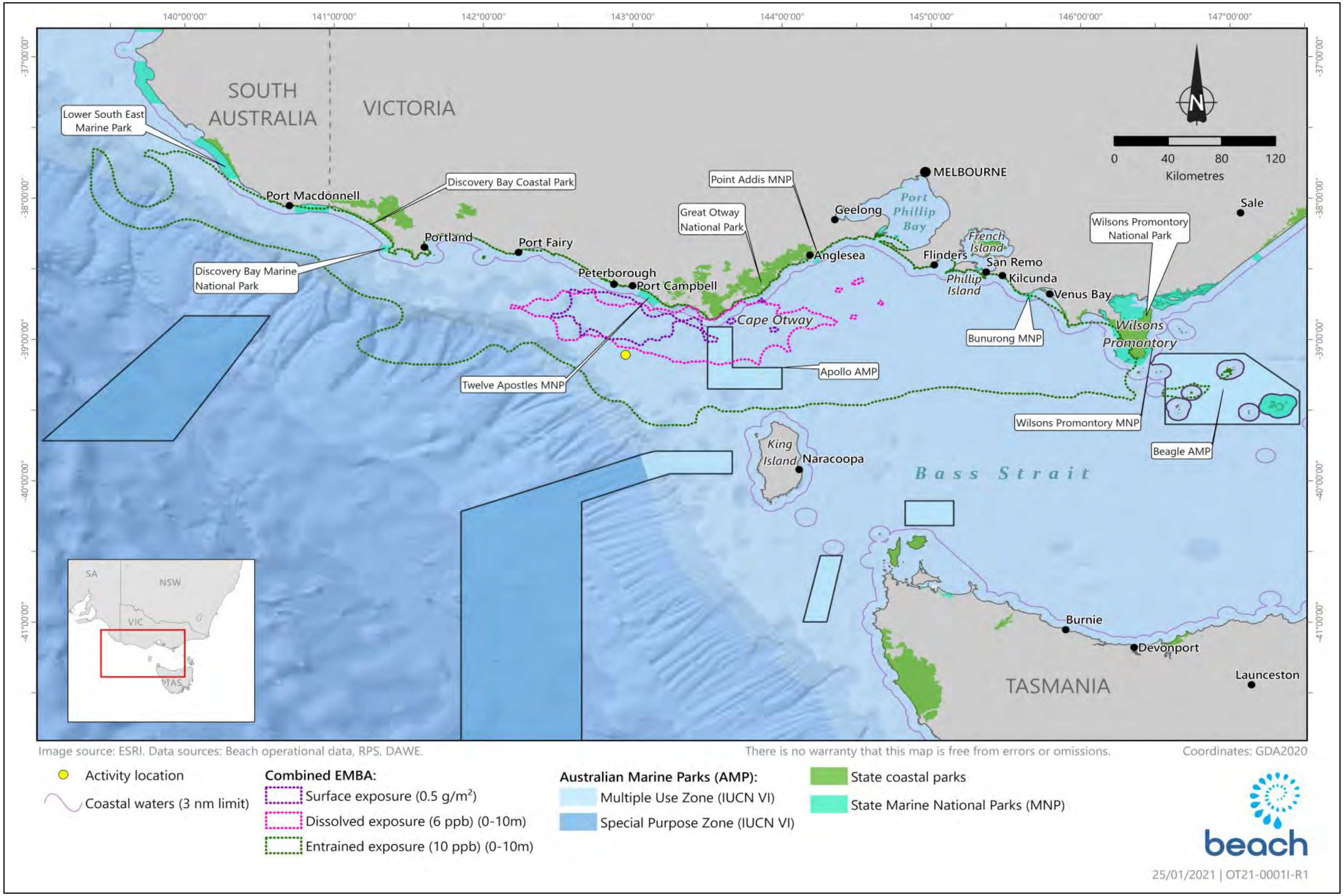


Figure 5.31. Protected areas in the activity area and spill EMBA

5.5.2 World Heritage-listed Properties

World Heritage Listed properties are examples of sites that represent the best examples of the world's cultural and heritage values, of which Australia has 19 properties (DAWE, 2020d). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the World Heritage List occur within the activity area or spill EMBA. The nearest site is the Royal Exhibition Building and Carlton Gardens in Melbourne, an onshore property located 227 km northeast of the activity area.

5.5.3 National Heritage-listed Places

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation (DAWE, 2020e). These places are protected under Chapter 5, Part 15 of the EPBC Act. The PMST Report identified the Great Ocean Road and Scenic Environs (Historic) and Point Nepean Defence Sites and Quarantine Station Area (historic). Both places are located onshore and do not contain marine or coastal components.

5.5.4 Wetlands of International Importance

Australia has 66 wetlands of international importance ('Ramsar wetlands') that cover more than 8.3 million hectares (as of March 2020) (DAWE, 2020c). Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity, and are included on the List of Wetlands of International Importance developed under the Ramsar Convention. These wetlands are protected under Chapter 5, Part 15 of the EPBC Act.

The spill EMBA PMST report (Appendix 5) identifies three marine or coastal Wetlands of International Importance, which are presented in Figure 5.32. The ecological character and values of these Ramsar listed wetlands are described in the following sections.

Ecological character is the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time. 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.

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

<u>Port Phillip Bay (Western shoreline) and Bellarine Peninsula</u>

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

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site provides important connective habitat for migratory bird species, habitat for fauna staging and foraging, is home to indigenous cultural sites, provides use of resources, and a site for commercial and recreational activities and education initiatives. The ecological character of the Ramsar site is reliant on the management of human activities and health of environment and water ways. In Victoria, the Victorian Waterway Management Strategy (VWMS) guides the management of rivers, estuaries and wetlands. The Ramsar site Management Plan (DELWP, 2018a) 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, 2018a).

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, 2018a), 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.

Westernport

Westernport is approximately 60 km south-east of Melbourne, Victoria and in 1982 a large portion was specified of international importance especially as a waterfowl habitat. The area consists of large shallow intertidal areas divided by deeper channels with an adjacent narrow strip of coastal land.

Westernport 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 wetland (Brown and Root, 2010).

Westernport is protected under the Westernport Ramsar Site Management Plan (DELWP, 2017), 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 Westernport 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.

Glenelg Estuary and Discovery Bay wetlands

The Glenelg Estuary is a large estuarine system consisting of the main channel of the Glenelg River and a side lagoon called the Oxbow. The physical features of the area include a geological setting of Quaternary lacustrine, paludal, alluvial and coastal sediments on Quaternary aeolian sediments (DAWE, 2020f).

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

There are ten wetland types within the Ramsar site generated by the interaction between geomorphology, hydrology and vegetation. Hydrology is a key driver in the character of the site. Water sources for the Glenelg Estuary include groundwater, rainfall, river inflows and tidal exchange. Many of the wetlands in the area are groundwater dependent and are seasonally closed off from tidal exchange. During summer low river flow is unable to move displaced sand from low constructive waves creating a sand barrier. When the estuary refills with fresh water the barrier is breached and open to tidal exchange. This process creates a salt wedge comprising of three distinct layers within the estuary. One of the key geomorphic features in the Ramsar site is the dune slack system. Determined by the hydrology of the dune system, vegetation and breeding of aquatic species is influenced by variations in flooding of the dune system. The site also provides a variety of habitat for waterbird feeding, roosting and breeding. Many migratory shorebirds may use the area as 'staging' areas are important for the bird's survival (DAWE, 2020f). The connection between the marine, estuarine and freshwater components is significant for fish migration and reproduction. There are several fish species contributing to the value of the site with different migratory strategies, also supporting fisheries elsewhere in the catchment. There is one nationally listed ecological community and eight nationally and internationally listed species of conservation significance supported in the Ramsar site.

The western end of Discovery Bay Coastal Park at the Glenelg Estuary is popular for fishing, boating, walking and other activities. The Major Mitchell Trail meets the coast here: the river mouth marks the end of Major Mitchell's expedition of 1836. The Great South West Walk traverses the estuary. Aboriginal culture: several shell middens and surface scatters exist at Glenelg Estuary (DAWE, 2020f).

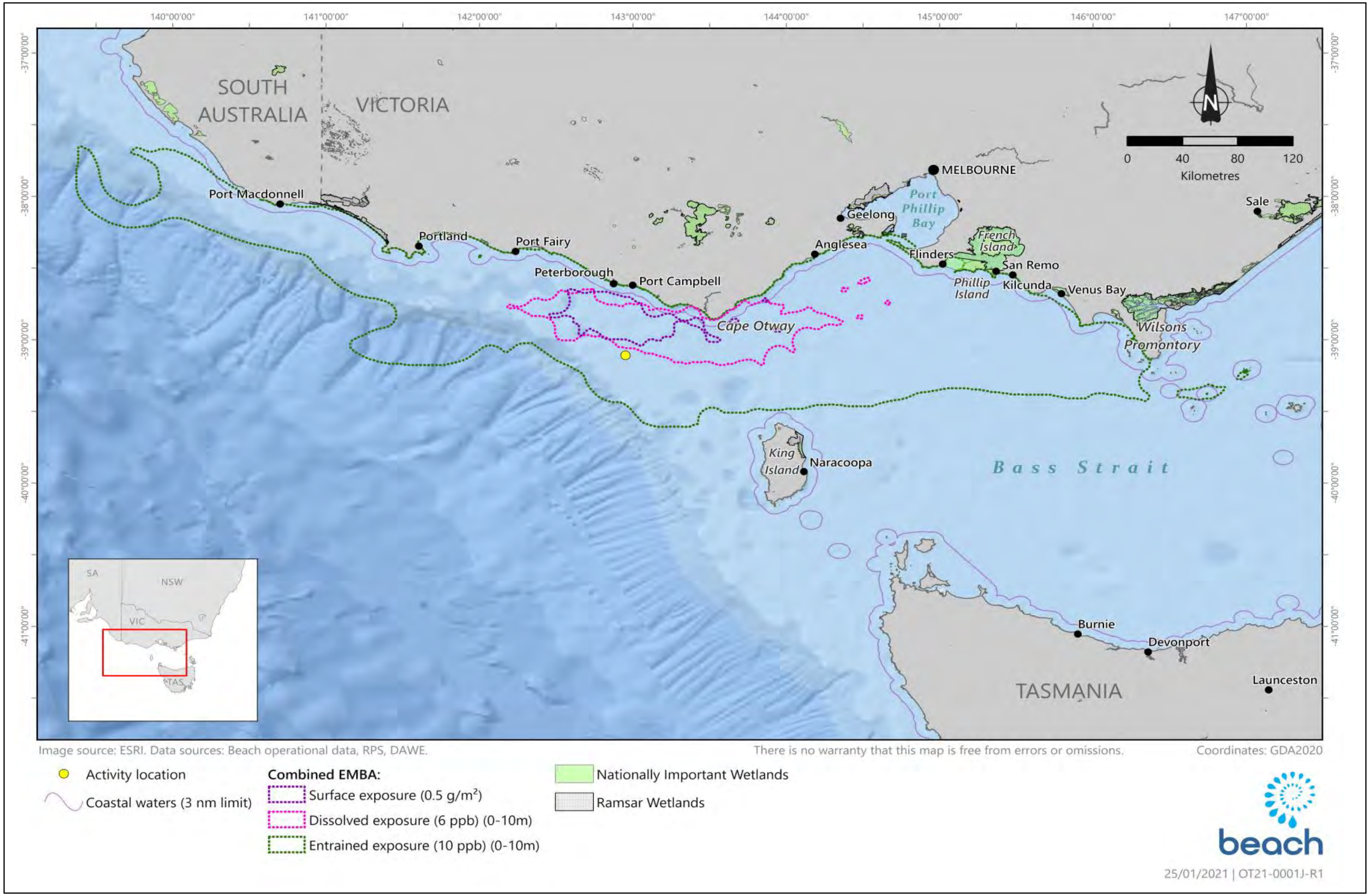


Figure 5.32. Ramsar and Nationally Important Wetlands in the activity area and spill EMBA

5.5.5 Commonwealth Heritage-listed Places

Commonwealth Heritage-listed places are natural, indigenous and historic heritage places owned or controlled by the Commonwealth (DAWE, 2020g). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

The spill EMBA PMST report (Appendix 5) identified several Commonwealth Heritage Places, most of which are historic heritage places located on land and therefore are outside the spill EMBA. The spill EMBA PMST report identified the Swan Island Defence Precinct (Historic, Listed place). This is discussed below.

Swan Island (and Naval Waters)

Swan Island is the largest emergent sand accumulation feature in Port Phillip Bay. The island, which has been built principally by wave actions rather than by aeolian forces, has played a major role in determining the pattern of sedimentation in Swan Bay and preserves geomorphological evidence of changing Quaternary sea levels. The eastern and northern shores of the eastern arm of Swan Island are of regional significance as an example of active coastal depositional and erosional processes (DAWE, 2020g).

Sand Island is the most important high tide roosting area in Swan Bay and at high tide regularly supports half of the shorebirds in the Swan Bay - Mud Islands complex. Sand Island maintains a regular breeding population of the fairy tern (*Sterna nereis*) and provides the main roosting habitat in Swan Bay for the nationally endangered little tern (*Sterna albifrons*) (DAWE, 2020g).

5.5.6 Threatened Ecological Communities

TECs are protected as MNES under Part 13, Section 181 of the EPBC Act and provide wildlife corridors and/or habitat refuges for many plant and animal species. Listing a TEC provides a form of landscape or systems-level conservation (including threatened species). The following TECs have been identified as occurring in the EMBA and are presented in Figure 5.33:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community
- Giant Kelp Marine Forests of South East Australia
- Subtropical and temperate coastal saltmarsh

Giant Kelp Marine Forests of South East Australia

According to the Approved Conservation Advice for Giant Kelp Marine Forests of South East Australia (DSEWPC, 2012b), giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs from the sea floor 8 m below sea level and deeper. Its fronds grow vertically toward the water surface, in cold temperate waters off southeast Australia. 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 (DSEWPC, 2012b).

Giant kelp is the largest and fastest growing marine plant. Its 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 star (*Ophiuroid sp*), urchins, sponges, blacklip abalone (*Tosia spp*) and southern rock lobster (*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 is a cold-water species and as sea surface temperatures have risen on the east coast of Australia over the last 40 years, it has been progressively lost from its historical range (DSEWPC, 2012b).

Giant kelp requires clear, shallow water no deeper than approximately 35 m below sea level (DSEWPC, 2012b). They are photoautotrophic 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 to 25 m. The largest extent of the ecological community is located in Tasmanian coastal waters.

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

According to the Approved Conservation Advice for the assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria, 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 (TSSC, 2018). 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).

Subtropical and temperate coastal saltmarsh

According to the Conservation Advice for Subtropical and Temperate Coastal Saltmarsh, this TEC occurs in a relatively narrow strip along the Australian coast, within the boundary along 23°37' latitude along the east coast and south from Shark Bay on the west coast of Western Australia (TSSC, 2013). The community is found in coastal areas which have an intermittent or regular tidal influence.

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

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

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.

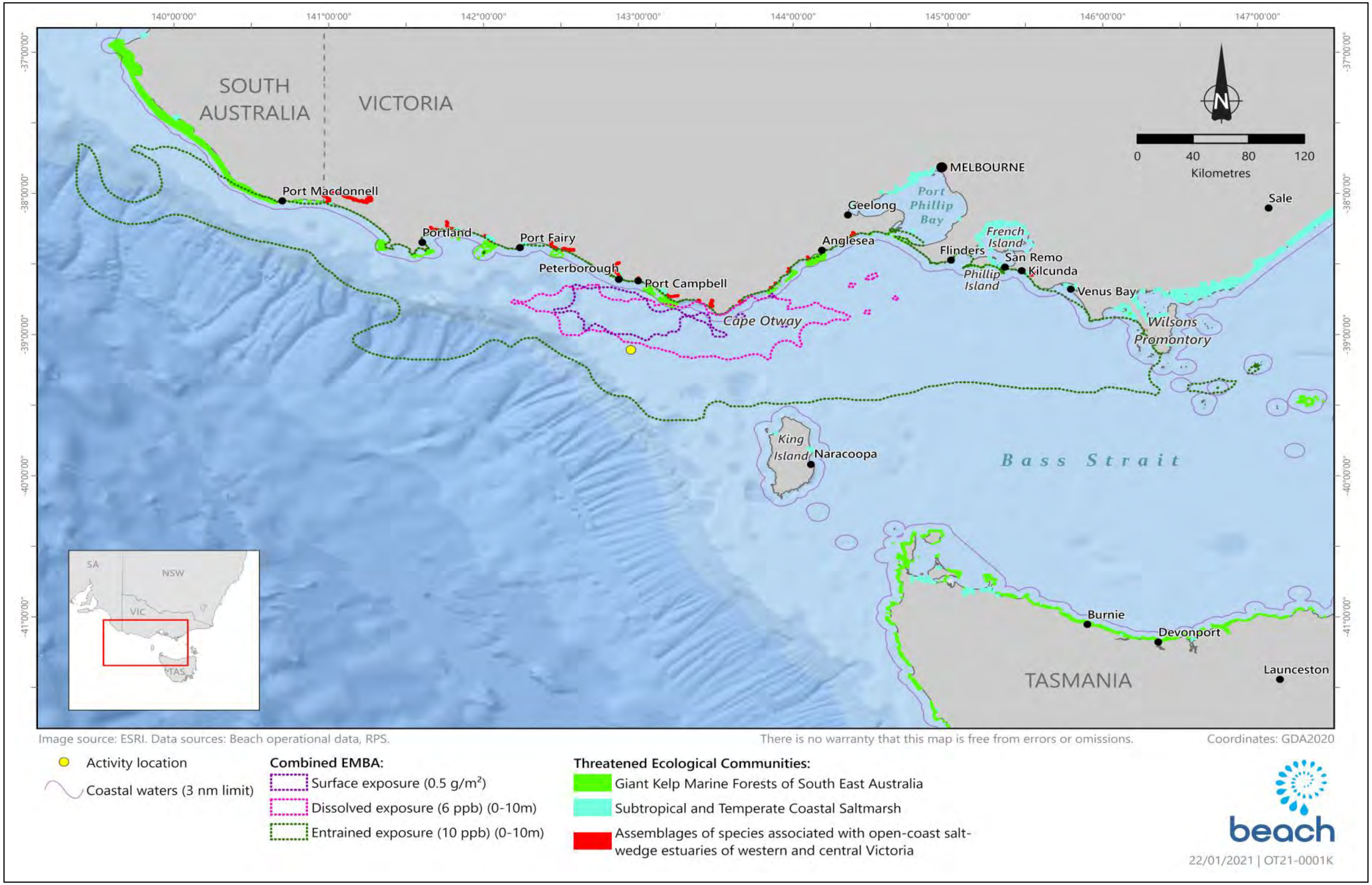


Figure 5.33. TECs intersected by the activity area and spill EMBA

5.5.7 Key Ecological Features

KEFs are elements of the Commonwealth marine environment that based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity. KEFs have no legal status in decision-making under the EPBC Act but may be considered as part of the Commonwealth marine area.

The activity area does not overlap any KEFs. The spill EMBA intersects the following two KEFs (Figure 5.34):

- Bonney Coast Upwelling (100 km west of the activity area), and
- West Tasmanian Canyons (31 km south of the activity area).

Bonney Coast Upwelling

The Bonney Upwelling is an area of high productivity and aggregations of marine life. It is a predictable, seasonal upwelling which brings of cold, nutrient rich water to the sea surface typically occurs in the summer and autumn along the narrow continental shelf between Robe, SA, and Portland, Victoria. Surface expression of the upwelling is only intermittent further to the southeast where the shelf is wider. Nonetheless the upwelling can extend to at least as far as Beach’s Thylacine gas platform (Levings & Gill 2010),

This Bonney Upwelling phenomenon generally starts in the eastern part of the Great Australian Bight in November/December and spreads eastwards to the Otway Basin around February (Gill *et al*., 2011) as the latitudinal high-pressure belt migrates southward. 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.

Ecological importance

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

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

The high productivity of the Bonney 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.

Variability

While the general characteristics of the Bonney Coast upwelling are broadly understood virtually nothing is known of the longer-term variability of the phenomenon. Alongshore wind is the predominant mechanism in the upwelling, which is, therefore, directly impacted by any changes to the strength or frequency of these winds. However, it should be noted, that not all favourable upwelling winds lead to an upwelling event.

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.

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 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. 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 (see Section 5.4.5) did not find a significant positive correlation between El Niño conditions and pygmy blue whale abundance. Such a positive correlation could be expected if El Niño conditions caused stronger upwelling, stronger upwelling led to increased planktonic productivity and blue whales were more likely to be present when productivity is higher.

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

Aerial surveys commissioned by Origin undertaken during February 2011 and November-December 2012 were undertaken during La Nina events classified by the 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.

West Tasmania Canyons

The West Tasmania 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 2009). The canyons in the Zeehan AMP (outside the EMBA) 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. 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 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 water depths of 150 m to 300 m.

Sponges are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m water depths. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts (DAWE, 2020b). Based upon this enhanced productivity, the West Tasmanian canyon system includes fish nurseries (blue warehou and ocean perch), foraging seabirds (albatross and petrels), white shark and foraging blue and humpback whales.

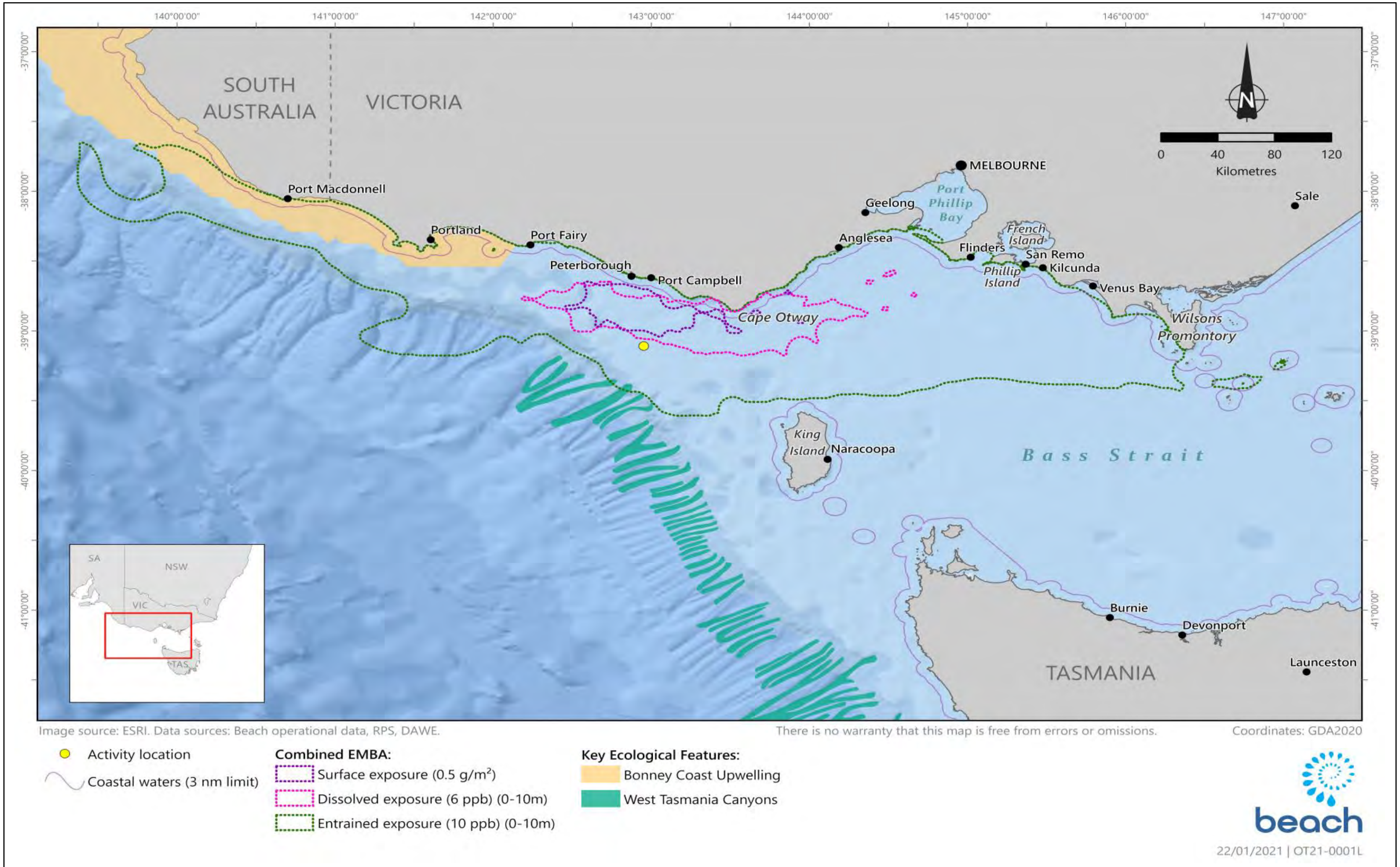


Figure 5.34. KEFs intersected by the activity area and spill EMBA

5.5.8 Nationally Important Wetlands

Nationally important wetlands (NIW) are considered important for a variety of reasons, including their importance for maintaining ecological and hydrological roles in wetland systems, providing important habitat for animals at a vulnerable stage in their life cycle, supporting 1% or more of the national population of a native plant or animal taxa or for its outstanding historical or cultural significance (DAWE, 2020f).

The activity area does not intersect any NIWs. Eight NIWs have been identified to occur along the coast that is intersected by the spill EMBA (Figure 5.32). These NIWs are described below, moving west to east, based on DAWE (2020f):

- Glenelg Estuary (VIC 030) - The Glenelg Estuary is a large estuarine system consisting of the main channel of the Glenelg River and a side lagoon called the Oxbow. The estuary is fed by the Glenelg River which originates in the Grampians Range. Its major tributaries are the Wannon, Stokes and Crawford Rivers. Water drained from wetlands in the Lindsay-Werrikoo Wetlands and Mundi-Selkirk enters the Glenelg River.
- Yambuk Wetlands (VIC 084) - The Yambuk Wetlands are a network of the estuary of the Eumeralla River and Shaw River (Lake Yambuk), associated freshwater meadows and semi-permanent saline wetlands. The Yambuk Wetlands are high value for their flora and fauna and they act as drought refuges. The vegetation consists of extensive reed beds and narrow bands of saltmarsh. Lake Yambuk is an excellent example of an estuary with extensive overbank swamps.
- Princetown Wetlands (VIC 093) - These wetlands consist of swamps of varying salinity on the floodplains of the Gellibrand River and its tributary, the Serpentine (Latrobe) Creek. Wetlands types present are a deep freshwater marsh, semi- permanent saline marshes and a shallow freshwater marsh. The Princetown Wetlands have extensive beds of Common Reed (*Phragmites australis*) and meadows dominated by Beaded Glasswort which can support large numbers of waterbirds. 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.
- Lower Aire River Wetlands (VIC 091) - 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.
- Lake Connewarre State Wildlife Reserve (VIC 116) - 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.
- Swan Bay and Swan Island (VIC 081) - Swan Bay is a shallow marine embayment partly enclosed by spits and barrier islands such as Swan Island. It is generally <2 m in depth, with 700-1,000 ha of mudflats exposed at low tide, and has extensive seagrass beds. The bay is fringed with saltmarsh including some extensive flats and there are some stands of remnant woodland. The bay is of high value for its avifauna and flora. It is very productive for birds, molluscs and fish. The saltmarsh and intertidal seagrass meadows are regionally significant. The avifauna is particularly diverse, with 190 bird species recorded. Swan Bay is a high value wetland for its ecological, recreational and educational features. Swan Bay is an unusual shallow embayment with a mixture of seagrass species which is relatively undisturbed and in good ecological condition.
- Mud Islands (VIC 077) - Mud Islands are a group of low, sandy islands located in the southern part of Port Phillip Bay. The islands are narrow and arranged in a roughly circular configuration around a central tidal lagoon. On the southern, western and northern shores, extensive intertidal mudflats and sea-grass meadows

are present. The islands have very high value for fauna since they support large numbers of migratory wading birds and breeding seabirds. Mud Islands has a high value for its ecological, recreational, scientific, educational and aesthetic features. It has a very high diversity of birds, 114 species, and is an important feeding and roosting site for many migratory birds. The wetland is an unusual offshore saltmarsh island complex providing breeding habitat for many birds. Mud Islands provides a wilderness experience for visitors.

- Westernport (VIC 083) - Western Port is a large bay with extensive intertidal flats, mangroves, saltmarsh, seagrass beds, several small islands and two large islands. Refer to description in Section 5.5.4.

5.5.9 **Victorian 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 15 marine protected areas and 14 onshore protected areas (i.e., reserves that extend to the low-water mark) intersected by the EMBA are shown in Figure 5.31 and described in Table 5.17, moving west to east along the EMBA.

5.5.10 **Tasmanian Protected Areas**

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).

The one marine protected area and 15 onshore protected areas intersected by the EMBA are shown in Figure 5.31 and described in Table 5.18, 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.

5.5.11 **South Australian Protected Areas**

South Australia has a large network of offshore protected areas that are established, protected and managed under the *Marine Park Act* 2007 by the Department for Environment and Water. Offshore, there are 19 marine parks in South Australia.

One marine protected area is intersected by the EMBA and shown in Figure 5.31 and described in Table 5.19, no terrestrial protected areas are intersected by the EMBA.

Table 5.17.Victorian marine and coastal protected areas in the spill EMBA

Name	Distance and direction from the activity area	Description
Marine protected areas		
Discovery Bay Marine National Park	161 km northwest.	The Discovery Bay Marine National Park is situated 20 km west of Portland and covering 2,770 ha and covers part of the largest coastal basalt formation in western Victoria. In deep water (30 – 60 m) there are low reefs forms from ancient shorelines or dunes. There is a rich diversity of marine life within this park due to the cold, nutrient rich waters of the area. The deep calcarenite reefs support diverse sponge gardens whilst the shallower reefs support the brown alga *Ecklonia radiata*. The offshore waters support a diverse array of invertebrates including southern rock lobster, black-lip abalone and gorgonians. The waters also support great white sharks and blue whales during the summer breeding season. The Discovery Bay National Park is protected as part of the Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (Parks Victoria, 2015) which covers over 116,000 ha of public land and freehold Gunditjmaraland in south-western Victoria. The Plan (Parks Victoria, 2015) describes some key values of the Discovery Bay (which includes the National Park and the coastal reserve), namely; • recognised roosting, feeding and nesting area for birds such as the hooded plover. • important habitat for the orange-bellied parrot. • subtidal reefs with giant kelp forest communities (TEC). • a foredune and dune complex that was formerly recognised on the National Estate. • surfing, boating and passive recreation. • tourism such as dune buggy tours.
Merri Marine Sanctuary	88 km northwest.	The Merri Marine Sanctuary is on the Victorian south-west coast near Warrnambool, approximately 260 km west of Melbourne. Merri Reefs Marine Sanctuary (25 ha) is located at the mouth of the Merri River, west of Warrnambool Harbour. Merri Marine Sanctuary contains a mixture of habitats, including intertidal reef, sand, shallow reef and rocky overhang. These areas provide a nursery for many fish species and a habitat for many algae species, hardy invertebrates and shorebirds. Bottlenose dolphins and fur seals are regular visitors to the shore (Parks Victoria, 2007a). The Sanctuary is protected with the Merri Marine Sanctuary Management Plan (Parks Victoria, 2007a) identifies the environmental, cultural and social values as: • culturally significant to indigenous communities that have a long association with the area. • Merri River, wetlands and islands and headlands provide a variety of habitats • provision of nursery for many fish species and habitat for algal species, hardy invertebrates and shorebirds.
The Arches Marine Sanctuary	51 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).

Name	Distance and direction from the activity area	Description
Twelve Apostles Marine and National Park	46 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 Marine Sanctuary	72 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	135 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.
Eagle Rock Marine Sanctuary	121 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).
Point Danger Marine Sanctuary	146 km northeast.	Point Danger Marine Sanctuary covers 25 ha and is located 20 km southwest of Geelong, close to the township of Torquay and nearby Jan Juc. It extends from the high-water mark at Point Danger offshore for approximately 600 m east and 400 m south, encompassing an offshore rock platform. It is managed in conjunction with Point Addis Marine National Park and Eagle Rock Marine Sanctuary.

Name	Distance and direction from the activity area	Description
Barwon Bluff Marine Sanctuary	161 km northeast	Barwon Bluff Marine Sanctuary covers 17 ha of Victorian waters and is located at Barwon Heads, approximately 100 km south-west of Melbourne. The Barwon Bluff Marine Sanctuary Management Plan (Parks Victoria, 2007c) identifies the key environmental values including intertidal and subtidal reefs that support a high diversity of invertebrate fauna and flora, marine habitats that are of scientific interest and intertidal habitats that support resident and migratory shorebirds.
Port Phillip Heads Marine National Park	171 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	192 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.
Bunurong MNP	238 km east-northeast. Extends over 5 km of coastline 2.5 km east of Cape Patterson in south Gippsland and reaches offshore for 3 nm to the limit of Victorian waters.	Bunurong MNP is significant because of the mixed assemblage of brown algae and seagrass, supporting a high proportion of Victoria's marine invertebrates, including brittle stars, sea cucumbers, barnacles, sea anemones and chitons. Bunurong MNP supports a considerable diversity of habitats and communities. These habitats provide important substrate, food, shelter and spawning and nursery areas for a variety of marine flora and fauna. Six marine ecological communities are present: sandy beaches, intertidal reef platform, subtidal reef, subtidal soft sediments, seagrass and open waters. Intertidal and subtidal reef communities are the most common habitat type and incorporate many microhabitats. Red, brown and green alga species, seagrass and seaweeds along with rocky substrate combine to form many microhabitats (Parks Victoria, 2006a). Sandy beaches of the park provide important habitat for invertebrates such as amphipods, isopods, molluscs, polychaetes and crustaceans, and are also a feeding ground for fish and seabirds. Beach-washed materials in sandy beach habitats provide a significant source of food for scavenging birds and contribute to the detrital cycle that nourishes many of the invertebrates, such as bivalves, living

Name	Distance and direction from the activity area	Description
		in the sand. Overall, the marine flora and fauna are considered largely representative of the Central Victorian Marine Bioregion (Parks Victoria, 2006a).
Bunurong Marine and Coastal Park	238 km east-northeast. Extends 7 km west and 3 km east along the coast from the national park and extends 1 km into the sea.	Bunurong Marine and Coastal Park has rugged sandstone cliffs, broad rock platforms and underwater reefs and significant fossil sites where dinosaur bones over 115 million years old have been excavated (Parks Victoria, 2006a). Bunurong Marine National Park is significant because of the mixed assemblage of brown algae and seagrass, supporting a high proportion of Victoria's marine invertebrates, including brittle stars, sea cucumbers, barnacles, sea anemones and chitons.
Wilsons Promontory MNP	289 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	288 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, 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)		
Discovery Bay Coastal Park	167 km northwest	The Discovery Bay Coastal Park is a remote coastal park that protects 55 km of ocean beach. Inland, the park encompasses high coastal cliffs, sand dunes, freshwater lakes and swamps, with thriving coastal vegetation and wildlife. The park extends along the coast of Discovery Bay from Cape Nelson north-westwards to the border of South Australia, covering an area of 10,460 ha (Parks Victoria, 2015).
Yambuk Wetlands Natural Conservation Reserve	131 km northwest	Yambuk Wetlands Natural Conservation Reserve is located south of Lake Yambuk along the coastline with an area of 0.77km^2 (Protected Planet, 2020). Yambuk wetlands are part of the Yambuk Important Bird Area and are formed in part by an estuarine lagoon which receives freshwater inflows from the Shaw and Eumeralla Rivers and, when open, from tidal seawater. When the mouth of the estuary is closed by a build-up of silt, the lake is flooded by freshwater until the entrance is opened mechanically. As well as the lake, the site contains associated wetland vegetation and adjacent protected areas which have suitable habitat for orange-bellied parrots and hooded plovers (BirdLife International, 2020).
Belfast Coastal Reserve	96 km northwest	The Belfast Coastal Reserve protects a narrow section of land backed by flat open farmland on the southwest Victorian coast. The Belfast Coastal Reserve features a variety of onshore ecosystems including the beach, vegetated areas of sandy beaches, coastal dune grasslands and scrub. It also includes estuary systems, which form the transition zone between river environments and marine environments. The

Name	Distance and direction from the activity area	Description
		reserve features significant archaeological and cultural heritage sites with Aboriginal shell middens found amongst the sandy dunes. The 20 km stretch of sandy beach and its associated dunes are recognised habitat for shorebirds, including pied oystercatchers, red-capped plovers and hooded plovers. The reserve is utilised for recreational activities including bird watching, surfing, dog walking and horseback riding (DELWP, 2018b).
Lady Julia Percy Island Wildlife Reserve	113 km northwest.	Lady Julia Percy Island is off the coast of Victoria near Port Fairy. It is one of the two largest breeding sites for the Australian fur seal species in Australia and provides habitat to migratory seabirds. There is no management plan for Lady Julia Percy Island Wildlife Reserve.
Bay of Islands Conservation Park	55 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	50 km northeast.	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	45 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 Spottailed 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 • The majority of the Aire Heritage River corridor.

Name	Distance and direction from the activity area	Description
Apollo Bay Coastal Reserve	73 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	104 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.
Swan Bay Wildlife Reserve	175 km northeast.	Swan Bay Wildlife Reserve is an internationally recognized wetland and marine ecosystem within Port Phillip Bay. Swan Bay supports diverse saltmarsh communities which form part of the habitat critical for survival of the endangered orange bellied parrot and is an important recreational and tourism resource (DELWP, 2018).
Mornington Peninsula National Park	180 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.
Phillip Island Nature Park	199 km northeast.	Phillip Island Nature Park spans multiple locations across the island from Cape Woolamai in the east, Smiths Beach in the South, Summerlands in the west and Cowes in the north. Due to its proximity to adjacent settlements, the Nature Park hosts a range of recreational activities including surfing, swimming, fishing, walking, running and bike riding. Cape Woolamai's cliffs are used by experienced rock climbers that allow for spectacular views of coastal scenery. The Cape is also the home to Phillip Island's largest shearwater rookery and numerous little penguin colonies. The penguins' nightly return from the ocean to their nests (the 'Penguin Parade' at Summerlands beach, outside the EMBA) is a key drawcard for tourists to Victoria and this part of the coastline. The Park also encapsulates Seal Rocks in the west, which is an important seal haul out site (PINP, 2018).

Name	Distance and direction from the activity area	Description
Cape Liptrap Coastal Park	257 km east.	Cape Liptrap Coastal Park protects extensive heathland and coastal forest vegetation communities, including scented paperbark, common heath, scrub she-oak, dwarf she-oak, pink swamp-heath, prickly teatree, silver banksia and bushy hakea. Several rare fauna species occur in the park including the hooded plover, swamp antechinus and powerful owl (Parks Victoria, 2003).
Wilsons Promontory National Park	290 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 5.18. Tasmanian marine and coastal protected areas in the spill EMBA

Note: where there are no official management plans available for protected areas, information has been obtained from the Protected Planet (2020) database.

Name	Location	Description
Onshore Protected Areas (where the EMBA intersects shorelines)		
Hogan Group Conservation Area	349 km east-southeast of the activity area.	The Hogan Group is located in Bass Strait south of Wilsons Promontory. The Hogan archipelago is an important seabird location and supports major breeding colonies of many species (Carlyon *et al.*, 2015). It is designated as IUCN Category IV which is habitat/species management area. There is no management plan for the Hogan Group Conservation Area.

Table 5.19. South Australian marine protected areas in the spill EMBA

Name	Location	Description
Onshore Protected Areas (where the EMBA intersects shorelines)		
Lower South East Marine Park	211 km northwest of the activity area.	The Lower South East Marine Park covers 360 km^2 and is divided into two sections: the area adjacent to Canunda National Park; and the area extending from Port MacDonnell Bay just west of French Point to the South Australian - Victorian border. The marine park borders Canunda National Park and partially overlays Piccaninnie Ponds Conservation Park. The Lower South East Marine Park Management Plan 2012 (DEWNR, 2012) details the following values: • high diversity of plants and animals, including blue whales, due to the influence of the Bonney coast upwelling, an ocean current that supplies nutrient-rich water to the area. • diverse range of habitats ranging from high-energy sandy beaches and freshwater springs, various reef types (shore platforms, fringing and limestone), kelp forests and algal communities and is strongly influenced by natural processes such as the Bonney coast upwelling.

Name	Location	Description
		• spring lakes such as Ewen Ponds and Piccaninnie Ponds (both Wetlands of National Importance) emerge from the beaches and are unusual in South Australia. • habitat for several threatened or potentially threatened species that require freshwater and marine environments during their lifecycle, including the pouched lamprey, short-headed lamprey and shortfinned eel. • feeding and resting grounds for migratory and resident shorebirds. • recreational activities including fishing, diving and snorkelling. • commercial fisheries including the Southern Zone Abalone Fishery, the Southern Zone Rock Lobster Fishery, the Marine Scalefish Fishery, the Charter Fishery and the Miscellaneous Giant Crab Fishery. • the Buandig Aboriginal people have traditional associations with areas of the marine park.

5.6 Cultural Heritage

Cultural heritage can be broadly defined as the legacy of physical science artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. Cultural heritage includes tangible culture such as buildings, monuments, landscapes, books, works of art, and artefacts, as well as intangible culture such as folklore, traditions, language, and knowledge, and natural heritage including culturally significant landscapes.

This section describes the cultural heritage values broadly categorised as Aboriginal and European heritage within the spill EMBA. The boundary of the spill EMBA includes the coastline up to the high-water mark.

5.6.1 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, 2006d).

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

5.6.2 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.

5.6.3 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 (DAWE, 2020h) and well-known wrecks include Loch Ard (1878), Thistle (1837), Children (1839), John Scott (1858) and Schomberg (1855).

None of the shipwrecks on the western section of the Victorian coast are covered by shipwreck protection zones declared under Section 103 of the *Victorian Heritage Act* 1995. On the central Victorian coast, a protection zone is in place around the shipwreck of the steamship *SS Alert*, which lies off Cape Schank, southeast of the entrance to Port Phillip Bay and within the spill EMBA. Six shipwreck protection zones occur within Port Phillip Bay (DAWE, 2020h) but are outside the EMBA.

A search of the Australasian Underwater Cultural Heritage Database indicates there are over 150 historic wrecks in the spill EMBA (Figure 5.35). Only one of these wrecks, the *SS Alert*, has a protection zone that is within the spill EMBA. There are no shipwrecks within the activity area.

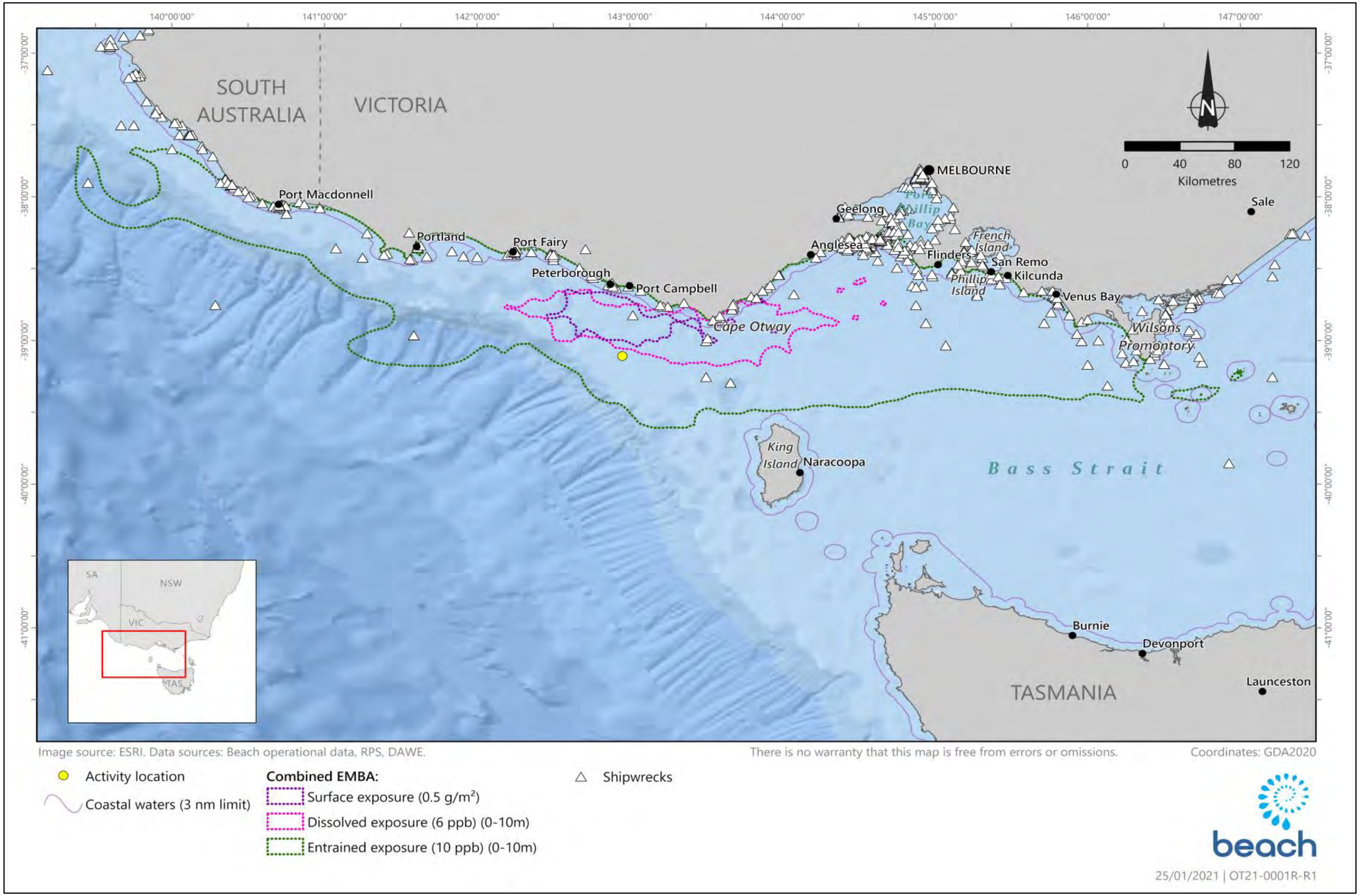


Figure 5.35. Known shipwrecks in the activity area and spill EMBA

5.7 Socio-economic Environment

This section describes the social and economic environment of the spill EMBA using data from the Australian Bureau of Statistics (ABS) (ABS, 2020). Note, no coastal settlements are predicted to be exposed to shoreline loading from an MDO spill. As such, only representative settlements intersected by the EMBA are briefly described here . The nearest settlements to the activity area are Princetown (49 km to the northeast) and Port Campbell (54 km to the north).

5.7.1 Coastal Settlements

The coastal settlements that lie within the spill EMBA and are subject to potential impact are (from west to east):

- South Australia - Port MacDonnell.
- Victoria - Cape Nelson, Portland, Port Fairy, Warrnambool, Peterborough, Childers Cove, Port Campbell, Princetown, Apollo Bay, Cape Patton, Lorne, Anglesea, Torquay, Kilcunda, Venus Bay, Cape Liptrap and Waratah Bay.

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

<u>Otway Region</u>

- Warrnambool has a population of 29,661 and a median age of 41. Of those in the labour force, 52.2% work full-time with 36.7% working part-time. The agriculture, forestry and fishing industries employ 2.1% of the workforce and the accommodation and food service industries employ 9.1%. Professionals, technicians and trade workers and managers make up 49.9% of occupations.
- Portland has a population of 9,712 and a median age of 45. Of those in the labour force, 50.3% work full-time with 35% working part-time. The agriculture, forestry and fishing industries employ 2.8% of the workforce and the accommodation and food service industries employ 8.8%. Professional, technicians and trade workers and clerical and administrative workers make up 42.3% of occupations.
- Port Fairy has a population of 3,340 and a median age of 50. Of those in the labour force, 51.1% work full-time with 36.5% working part-time. The agriculture, forestry and fishing industries employ 6.5% of the workforce and the accommodation and food service industries employ 12.8%. Professionals, Managers and technicians and trade workers make up 54.9% of occupations.
- Port Campbell has a population of 478 and a median age of 38. Of those in the labour force, 55.6% work full-time and 32.2% work part-time. The accommodation and dairy farming industries employ 23.8% of the workforce and the. Managers, labourers and professionals make up 63.3% of occupations.
- Torquay has a population of 13,258 people and a median age of 39. Of those in the labour force, 55.2% work full-time with 35.5% working part-time. The agriculture, forestry and fishing industries employ 0% of the workforce. The primary and secondary education industries employ 5.9% of the workforce. Professionals, managers and technicians and trade workers make up 56.4% of occupations.

<u>Port Phillip Bay</u>

- Mornington Peninsula (Shire) has a population of 154,999 people and a median age of 46. 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.

- Queenscliff has a population of 1,315 people and a median age of 59. Of those in the labour force, 45.6% work full-time with 45.6% working part-time. The accommodation, cafes and restaurants and primary education industries employ 16.8% of the workforce. Professionals, managers and clerical and administrative workers make up 59% of occupations.

Bass Coast

- Wonthaggi has a population of 4,965 people and a median age of 52, occupying 2,400 dwellings. The greatest proportion of the population are employed as technicians, trade workers and labourers.
- Cape Paterson has a population of 891 people and a median age of 52. There are 1,077 private dwellings and the median weekly household income is $897. Professionals and technicians and trades workers were the two most common occupations at 22.4% and 17.6%, respectively.
- Inverloch, with a population of 5,437, had 47.6% of its 4,290 dwellings permanently unoccupied. The area is a popular tourist destination, particularly for swimming, kitesurfing and windsurfing in the calm waters of Anderson Inlet. Fishing and surfing are also popular.

5.7.2 Offshore energy 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.

5.7.3 Other Infrastructure

The Victorian Desalination Plant, located at Wonthaggi, is located 230 km northeast of the activity area and within the EMBA for entrained MDO. 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 5.36), with the closest one located 227 km southeast of the activity area.

The Indigo Central telecommunications cable, which connects Perth and Sydney through southern Australia, is located 33 km south of the activity area.

5.7.4 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.

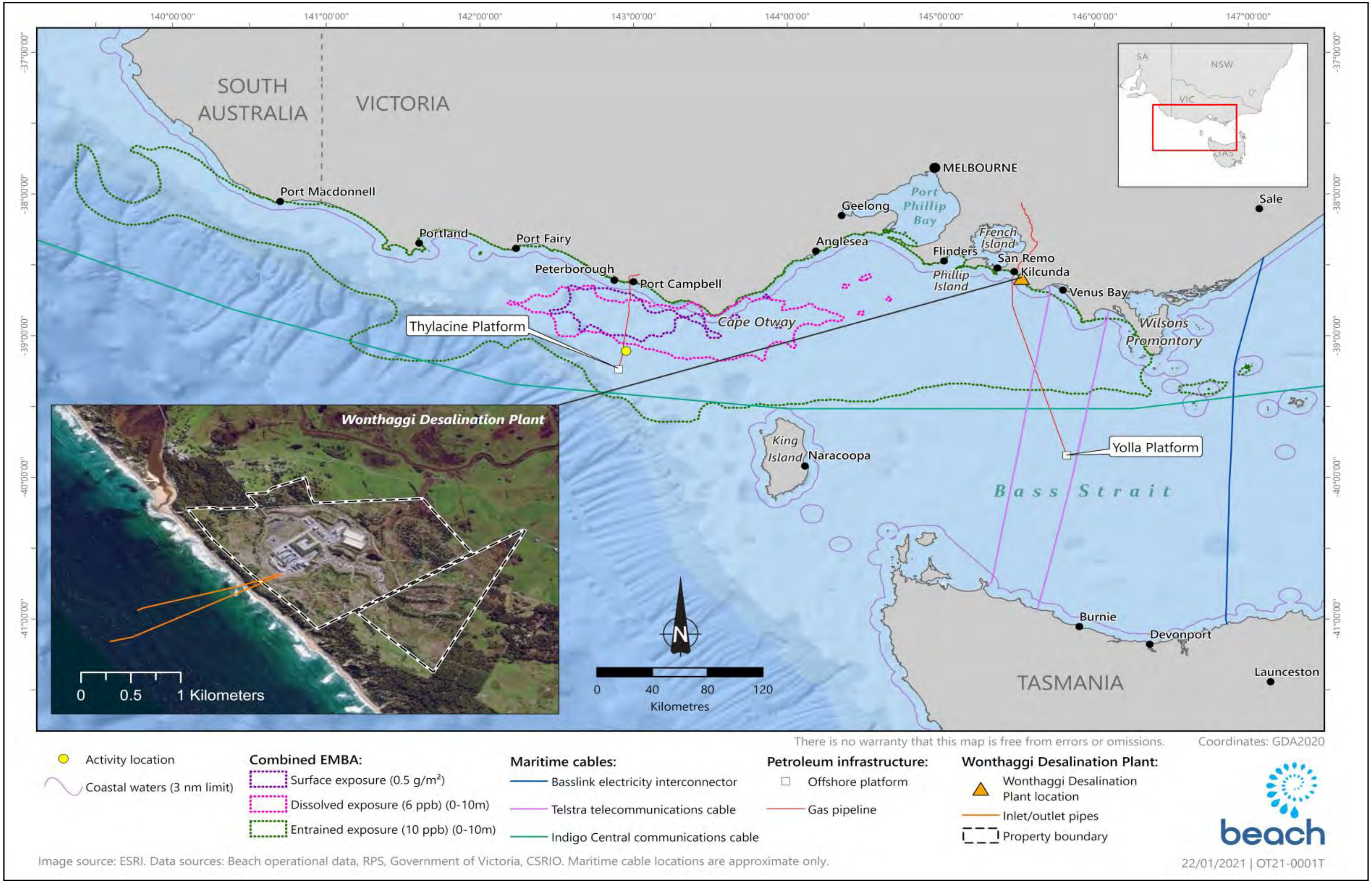


Figure 5.36. Bass Strait subsea infrastructure intersected by the activity area and spill EMBA

5.7.5 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.

Beach's historic 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 include:

- Rock lobster
- Abalone
- Scallops
- Squid

5.7.6 Commercial Fisheries

The spill EMBA intersects several Commonwealth-, Victorian- and Tasmanian-managed commercial fisheries. These are described here.

<u>Commonwealth-managed fisheries</u>

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 5.20 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 5.20. Commonwealth-managed commercial fisheries in the EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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 and Eastern Scalefish and Shark Fishery (SESSF)							
Shark Gillnet (Figure 5.37) and Shark Hook (Figure 5.38) 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.	**Activity area?** **No.** The activity area is located within an existing Petroleum Safety Zone (PSZ) where fishing is not permitted. The activity area intersects 0.00006% of the total fishery area. **EMBA?** **Yes.** Based on 2019-20 fishing intensity data, the spill EMBA overlaps areas of low, medium and high intensity fishing. The spill EMBA intersects 3.18% of the fishery.	12-month season begins 1st May.	Demersal gillnet and a variety of line methods. Landing ports in Victoria are Lakes Entrance, San Remo and Port Welshpool. 2019-20 – 74 permits and 71 active vessels. 2018-19 – 74 permits and 78 active vessels. 2017-18 – 74 permits and 76 active vessels. 2016-17 – 74 permits and 62 active vessels.	In 2015-16, the SESS Fishery was the largest Commonwealth fishery in terms of volume produced. • 2019-20 – 2,201 tonnes with no value assigned. • 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.	Fishing catch and effort was reported from the activity area in 2019-20 but not areas of relatively low, medium or high fishing intensity.
Commonwealth Trawl Sector (CTS) (Figure 5.39a&b)	Key species targeted are eastern school whiting (*Sillago flindersi*), flathead (*Platycephalus*	Covers the area of the AFZ extending southward from Barrenjoey Point	**Activity area?** **No.** The activity area is located within an existing PSZ	12-month season begins 1st May.	Multi gear fishery, but predominantly demersal otter trawl and Danish-seine methods.	Logbook catches have been gradually declining since 2001. • 2019-20 – 13,148 tonnes with no value assigned.	Fishing catch and effort was reported from the grid overlapping the activity area for the 2019-20 fishing season.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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)
	richardsoni) and gummy shark (*Mustelus antarcticus*).	(north of Sydney) around the New South Wales, Victorian and Tasmanian coastlines to Cape Jervis in South Australia.	where fishing is not permitted. The activity area intersects 0.00007% of the fishery. **EMBA?** **Yes.** Based on 2019-20, fishing intensity data, the spill EMBA overlaps areas of low, medium, and high fishing intensity. The spill EMBA intersects 3.8% of the fishery.	Highest catches from September to April.	Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria. For 2019-20, there were 57 trawl fishing rights with 49 active trawl and Danish-seine vessels.	• 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.	
Scalefish Hook Sector (SHS) (Figure 5.40)	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?** **No.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.00004% of the fishery. **EMBA?** **Yes.**	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	Logbook catches have been gradually declining since 2006 and are now <2,000 t/year. Catch data is combined with that for the CTS.	Fishing catch and effort was reported from the grid overlapping the activity area for the 2019-20 fishing season.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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)
			Based on 2019-20 fishing intensity data, the spill EMBA overlaps part of the total area of waters fished. The spill EMBA intersects 1.88% of the fishery.		Entrance and Portland in Victoria.		
Southern Squid Jig Fishery (Figure 5.41)	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.	**Activity area?** **No.** The activity area is located within an existing PSZ where fishing is not permitted. The acquisition area intersects 0.00003% of the total fishery. **EMBA?** **Yes.** The spill EMBA intersects 1.76% of the fishery, but in an area of low fishing intensity.	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 2019 there were 8 active vessels. Hobart, Portland and Queenscliff are the primary landing ports.	The species' short life span, fast growth and sensitivity to environmental conditions result in strongly fluctuating stock sizes. • 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.
Bass Strait Central Zone Scallop Fishery (Figure 5.42)	Commercial scallop (Pecten fumatus)	Central Bass Strait area that lies within 20 nm of the Victorian and Tasmanian coasts.	**Activity Area?** **No.** The activity area is located within an existing PSZ	19th July to 31st December.	Towed scallop dredges that target dense aggregations ('beds') of scallops. 48 fishing permits are in place.	• 2019 – 2,931 tonnes with $6.3 million. • 2018 – 3,253 tonnes worth $6.7 million.	No fishing catch or effort was reported from the activity area in 2019.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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)
		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.	where fishing is not permitted. The activity area intersects 0.0005% of the fishery. **EMBA?** **Yes.** Based on 2019-20 fishing intensity data, the spill EMBA overlaps part of the total area of waters fished. The spill EMBA intersects 13.53% of the fishery.		12 vessels were active in the fishery in 2019, a decrease from 26 active vessels in 2009, reflecting the 'boom or bust' nature of the fishery.	• 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.	
Southern Bluefin Tuna (Figure 5.43)	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 effort is concentrated along the NSW south coast around the 200 m depth contour.	**Activity area?** **No.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.00001% of the fishery. **EMBA?** **No.** The spill EMBA intersects 0.68% of the fishery, but	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: • 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.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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)
			in an area that is not fished.				
Small Pelagic Fishery (eastern and western sub-area) (Figure 5.44)	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.	**Activity area?** **No.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.00003% of the fishery. **EMBA?** **No.** The spill EMBA intersects 1.42% of the fishery, but in an area that is not fished.	12-month season begins 1st May.	Purse seine and mid-water trawl, with the latter being the main method. Thirty (31) entities held licences in 2018-19 using four active vessels. The main landing ports are in Tasmania, South Australia and New South Wales, along with Geelong in Victoria.	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. • 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 (Figure 5.45)	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.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.00002% of the fishery. **EMBA?** **No.**	12-month season begins 1st March.	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).	Catch data and economic value available for the last five years: • 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.	No fishing catch or effort was reported from the activity area in 2019.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the 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)
			The spill EMBA intersects 1.26% of the fishery, but in an that was not fished in 2019.		No Victorian or Tasmanian ports are used to land catches.	Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012).	
Eastern Skipjack Tuna Fishery (Figure 5.46)	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. **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.	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).

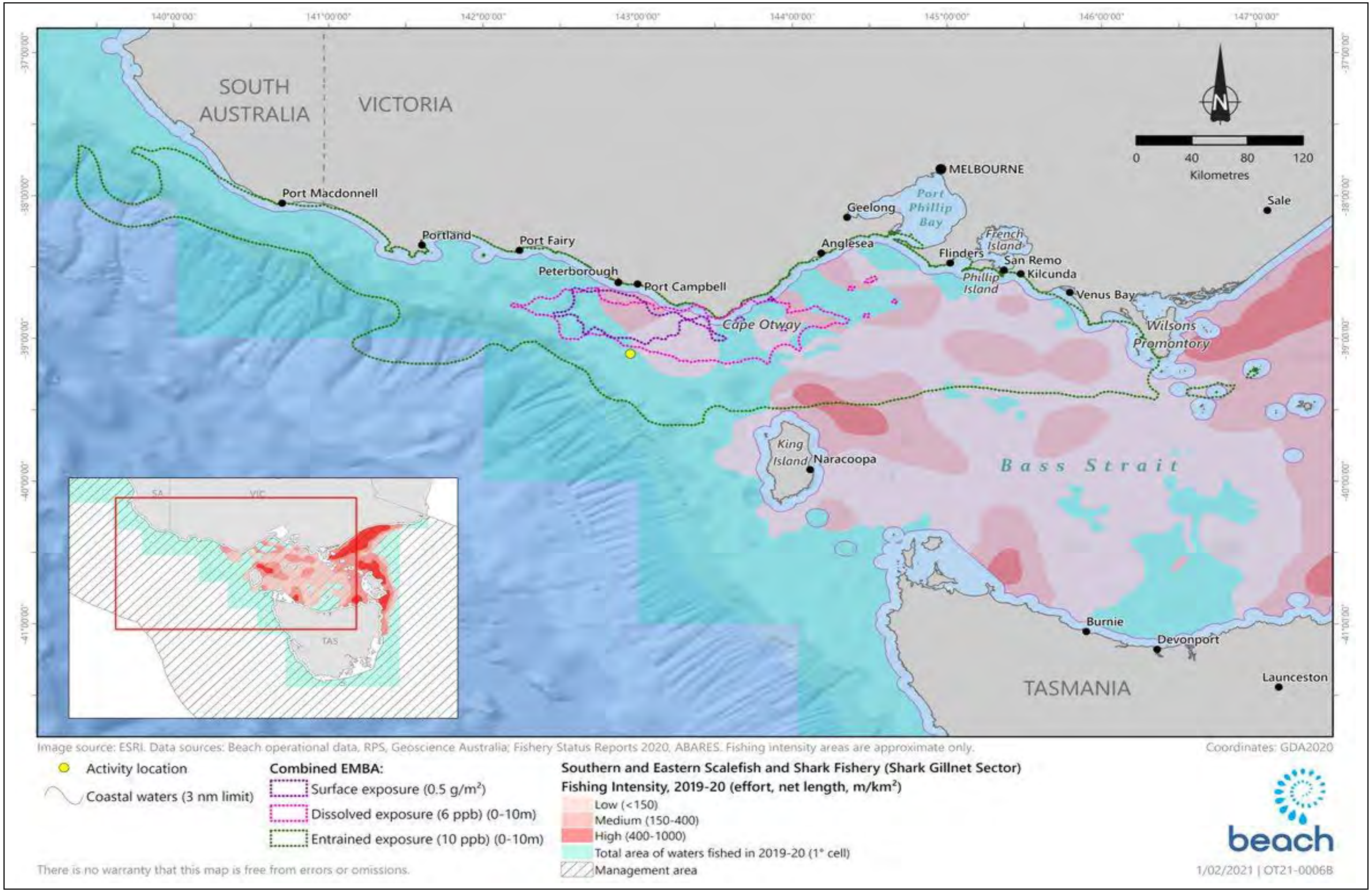


Figure 5.37. Jurisdiction of and fishing intensity in the Commonwealth SESS – shark gillnet sector 2019-20

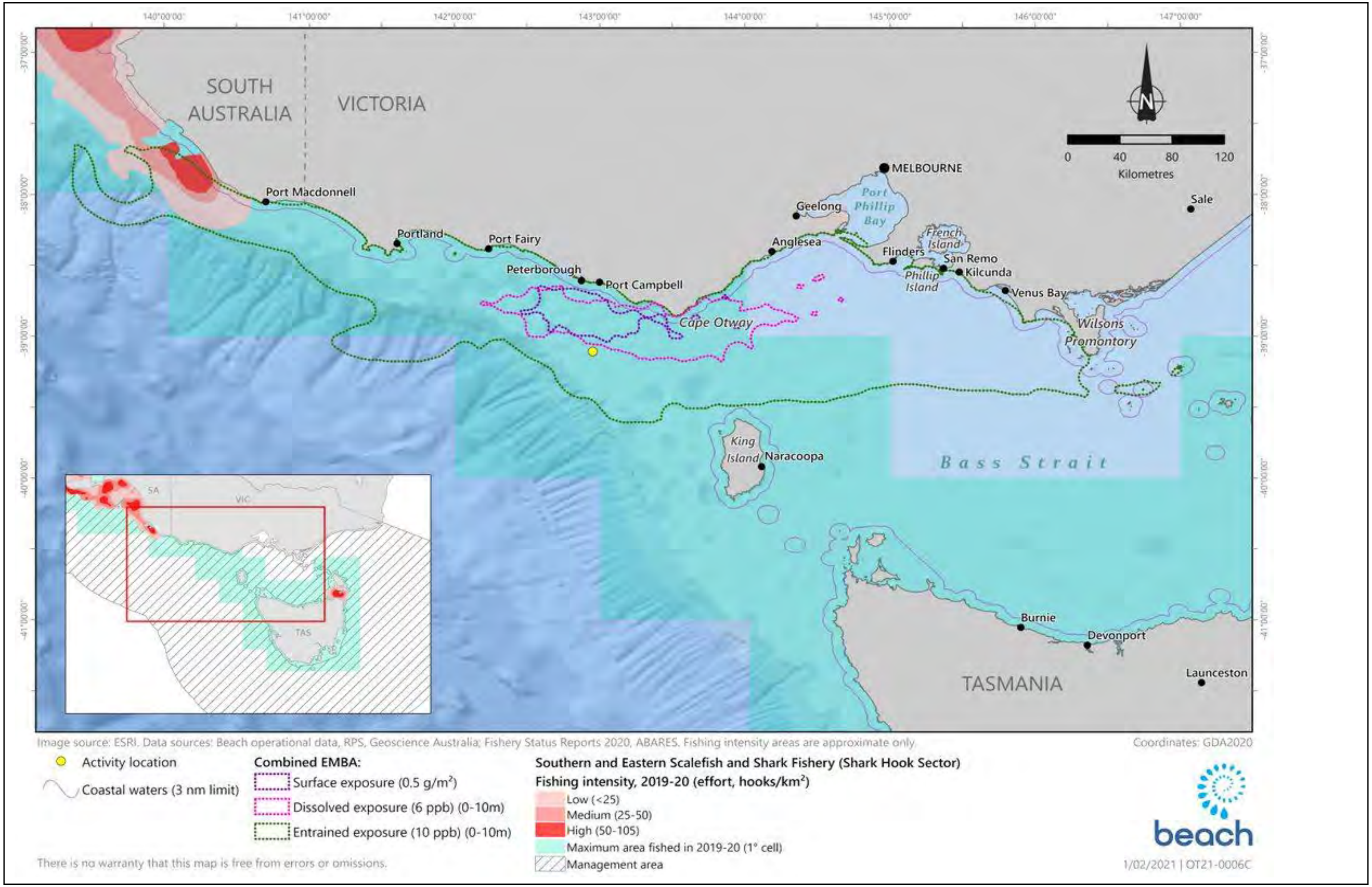


Figure 5.38. Jurisdiction of and fishing intensity in the Commonwealth SESS – Shark Hook Sector 2019-20

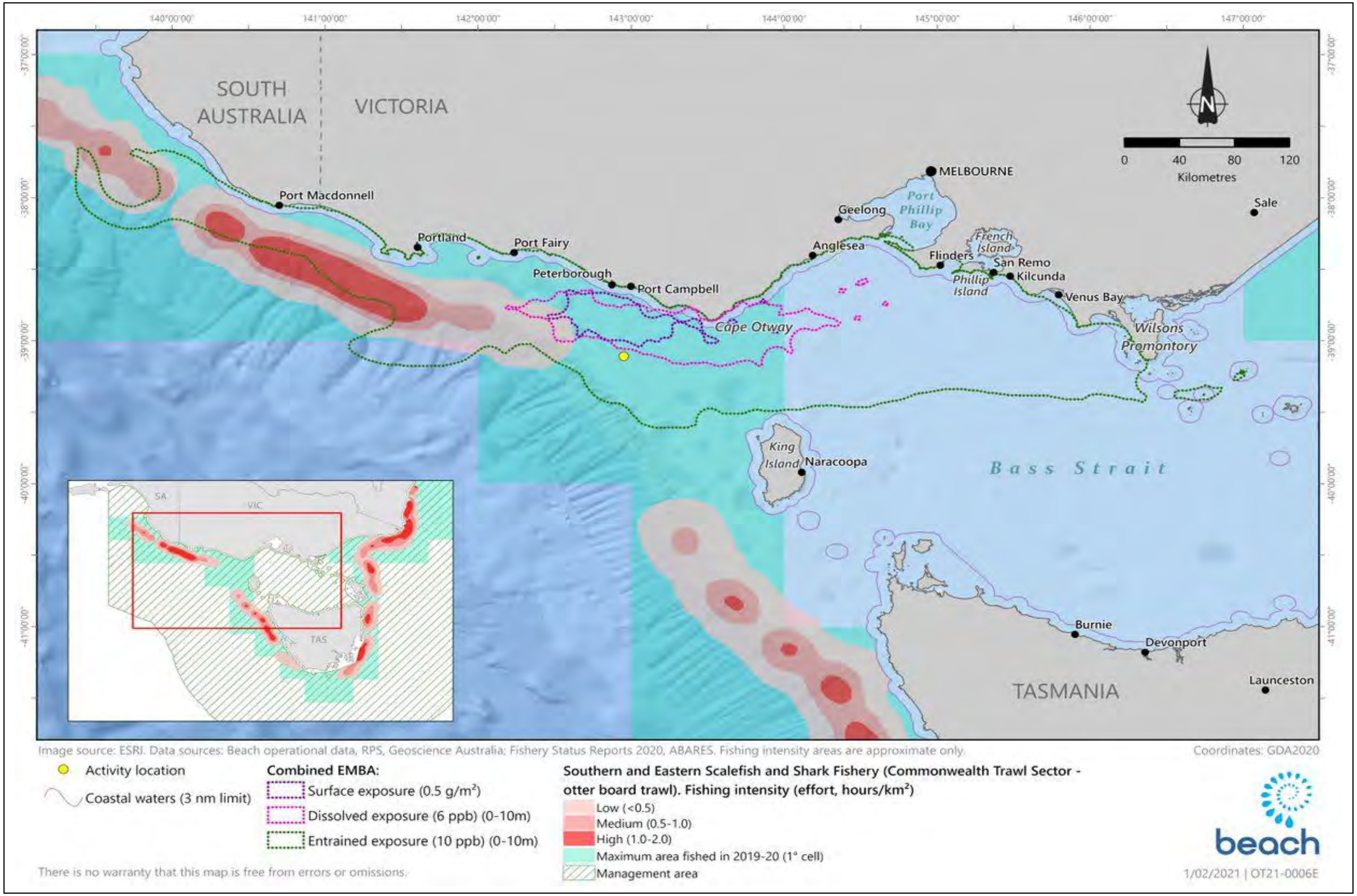


Figure 5.39a. Jurisdiction of and fishing intensity in the Commonwealth SESS – Commonwealth trawl sector 2019-20

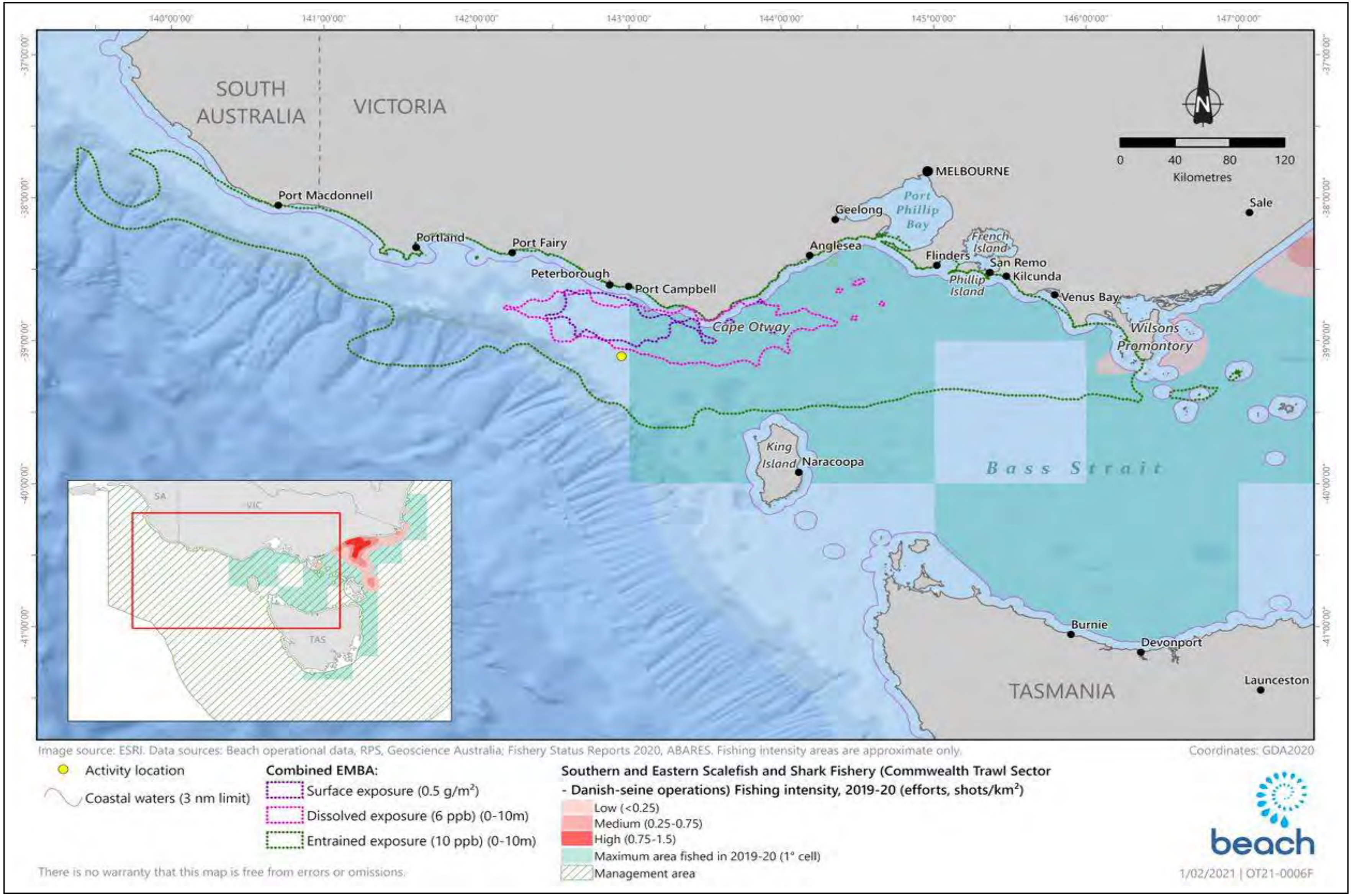


Figure 5.39b. Jurisdiction of and fishing intensity in the Commonwealth SESS - Danish seine operations 2019-20

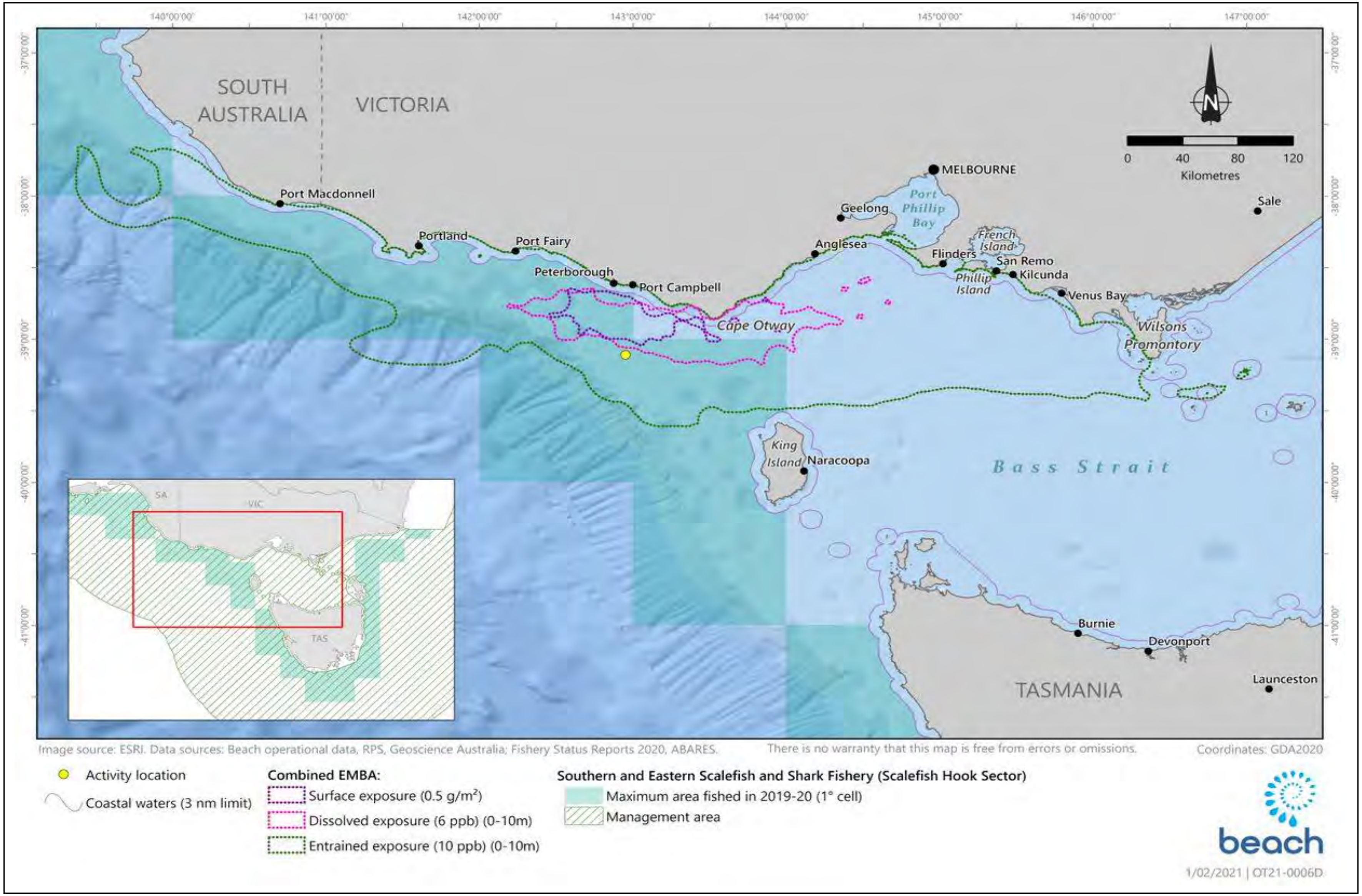


Figure 5.40. Jurisdiction of and fishing intensity in the Commonwealth SESS – Scalefish Hook Sector 2019-20

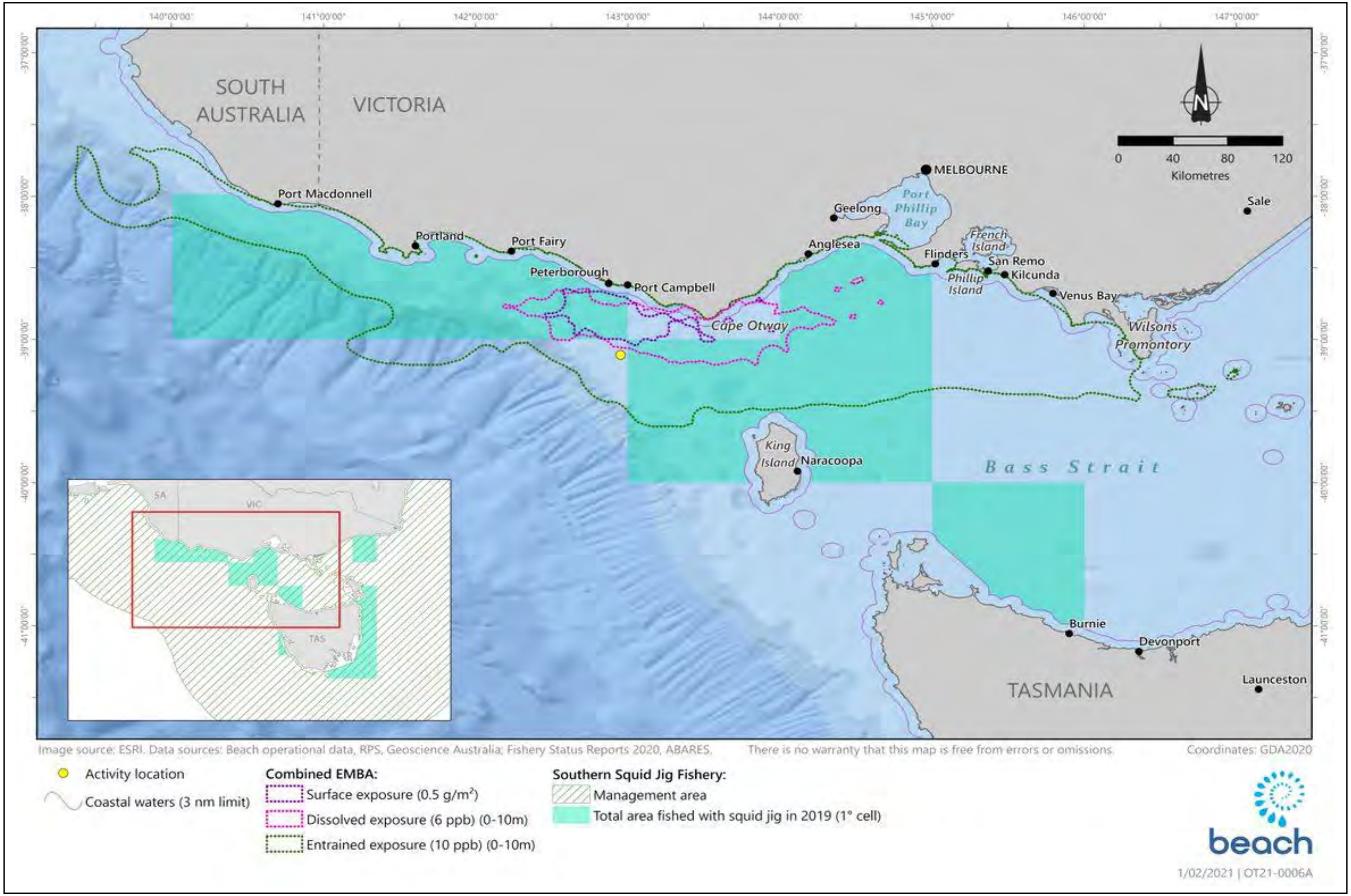


Figure 5.41. Jurisdiction of and fishing intensity in the Commonwealth southern squid jig fishery 2019

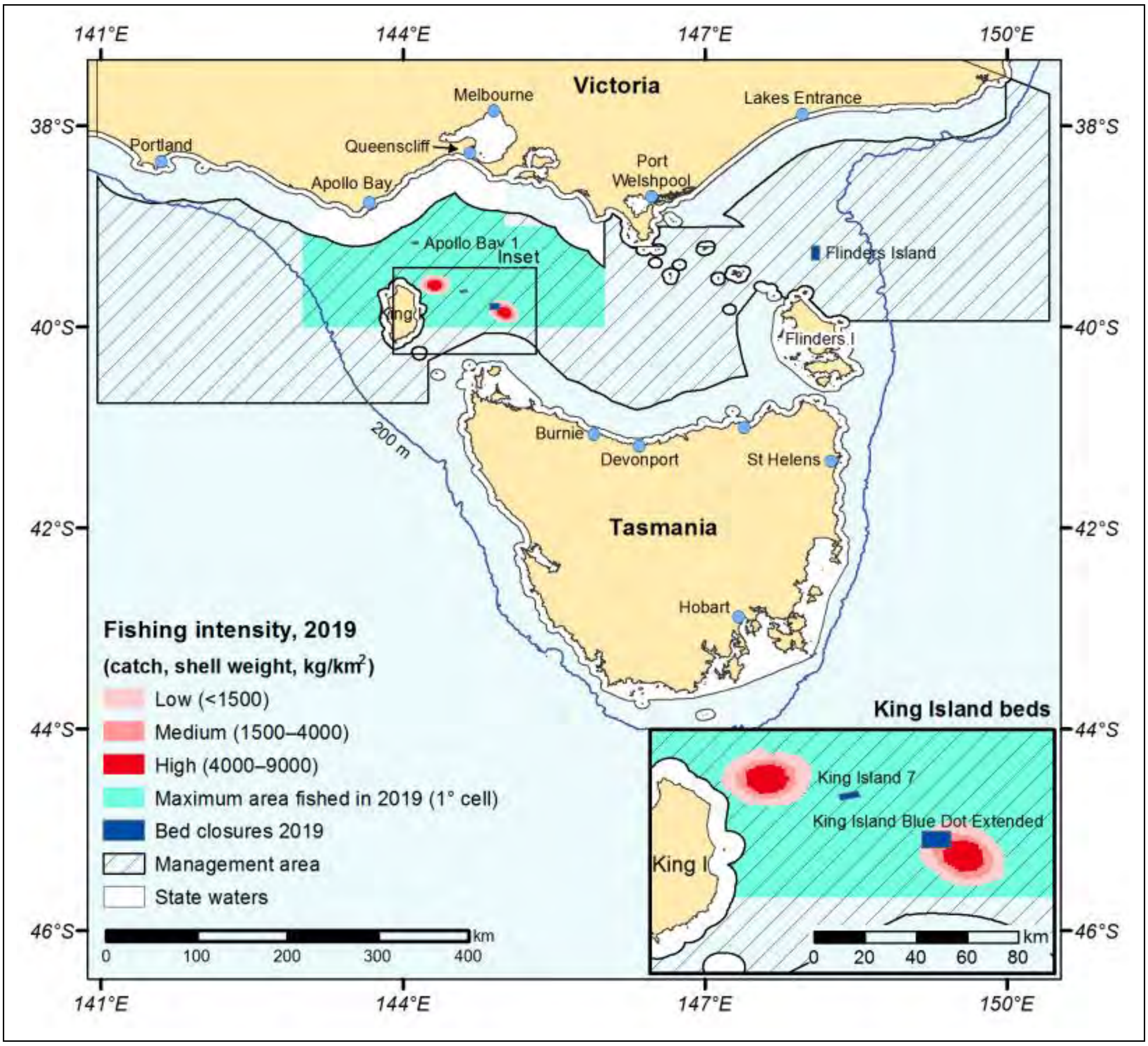


Figure 5.42. Jurisdiction of and fishing intensity in the Commonwealth Bass Strait Central Zone Scallop Fishery 2019

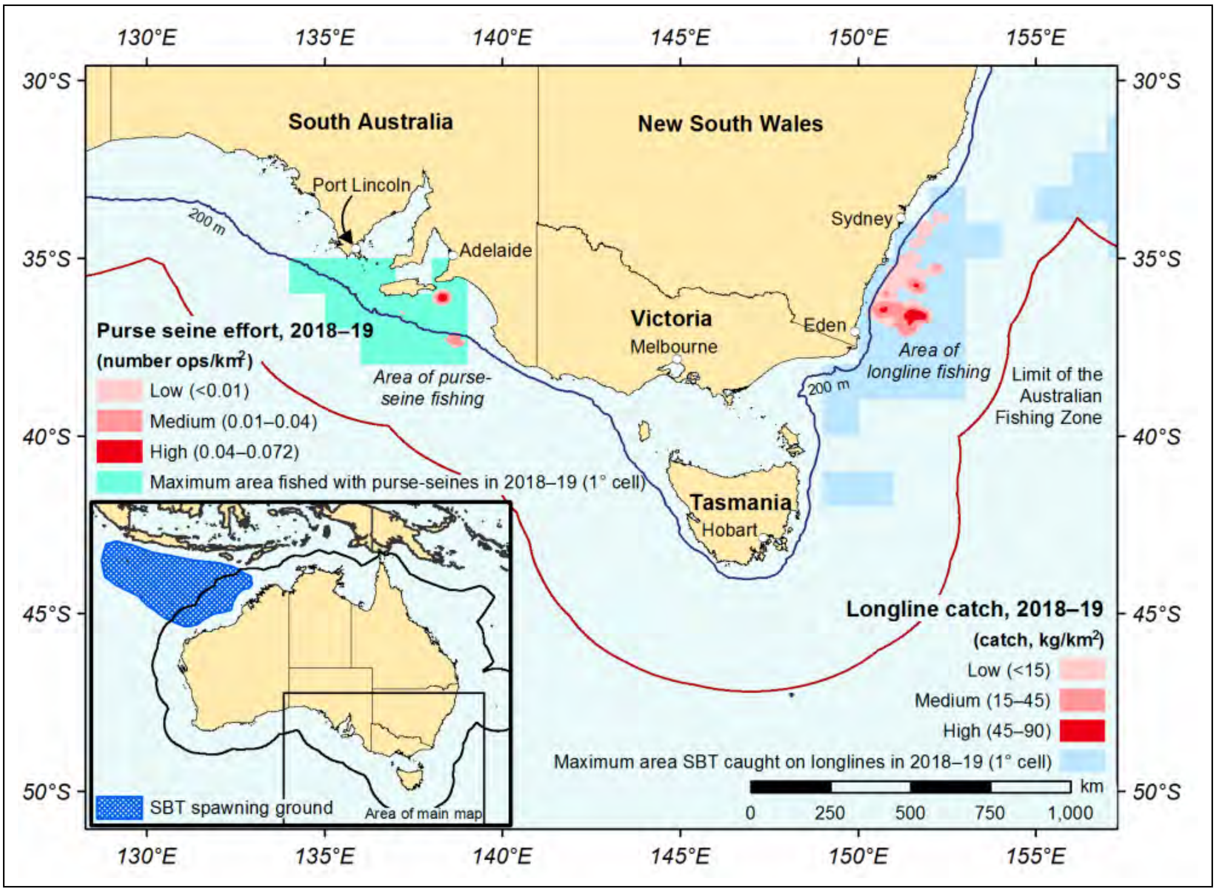
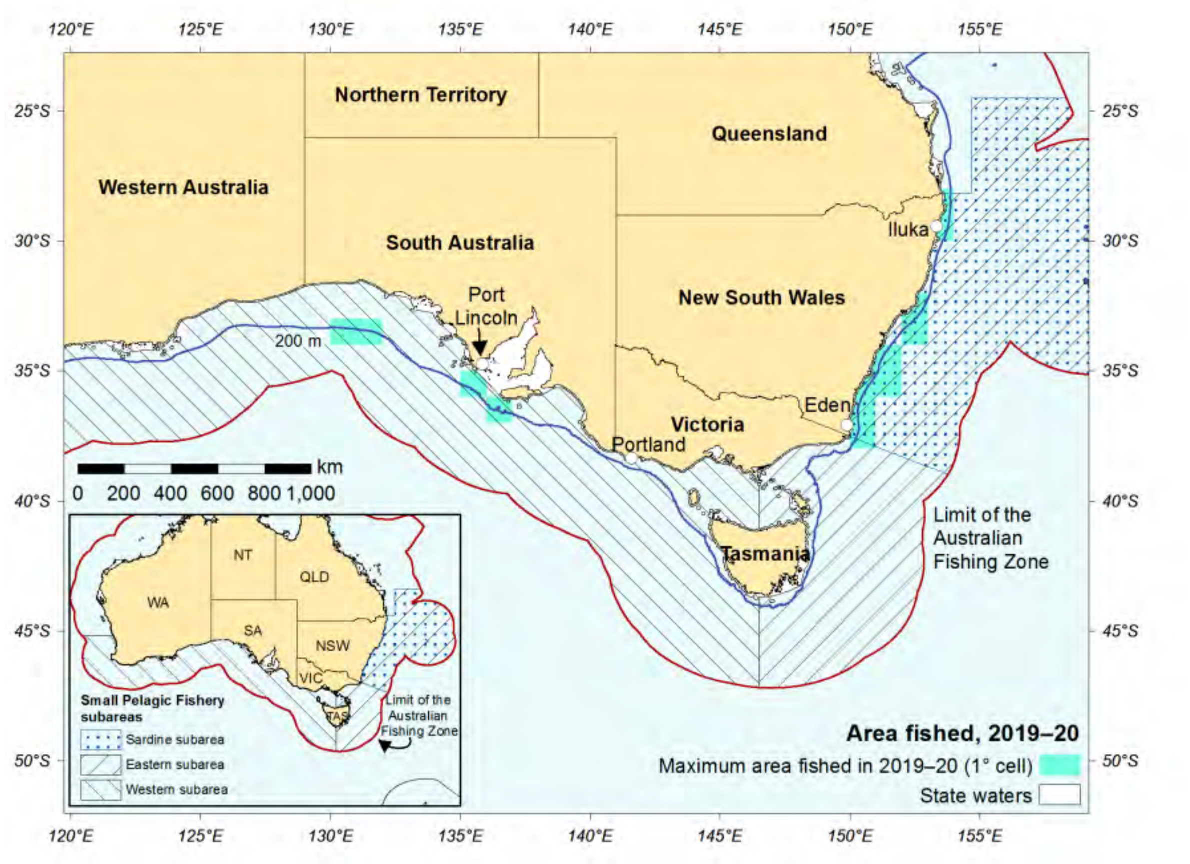


Figure 5.43. Jurisdiction of and fishing intensity in the Commonwealth Southern Bluefin Tuna Fishery 2018-19



Some effort data not shown for confidentiality reasons.

Figure 5.44. Jurisdiction of and fishing intensity in the Commonwealth small pelagic fishery 2019-20

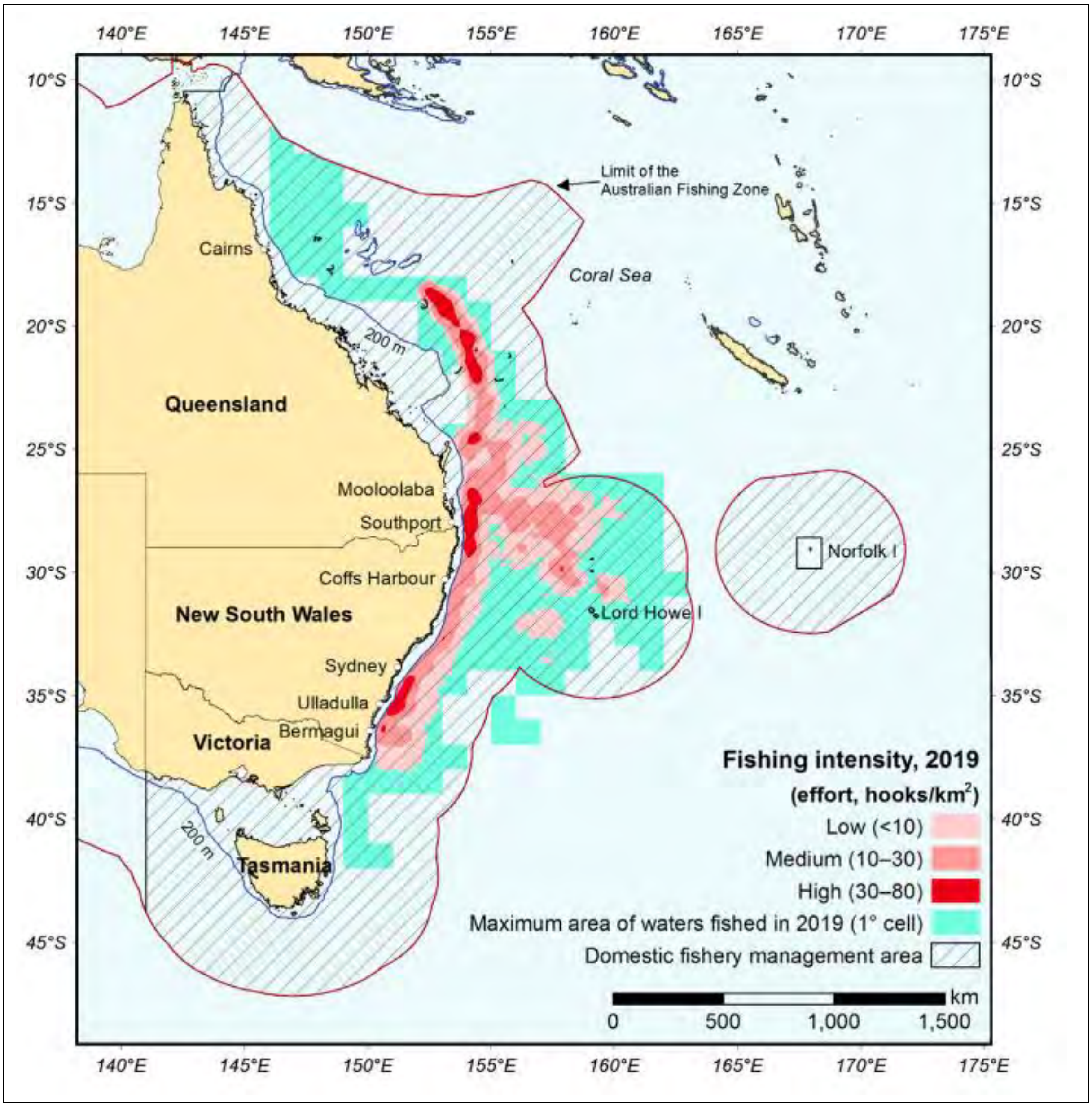
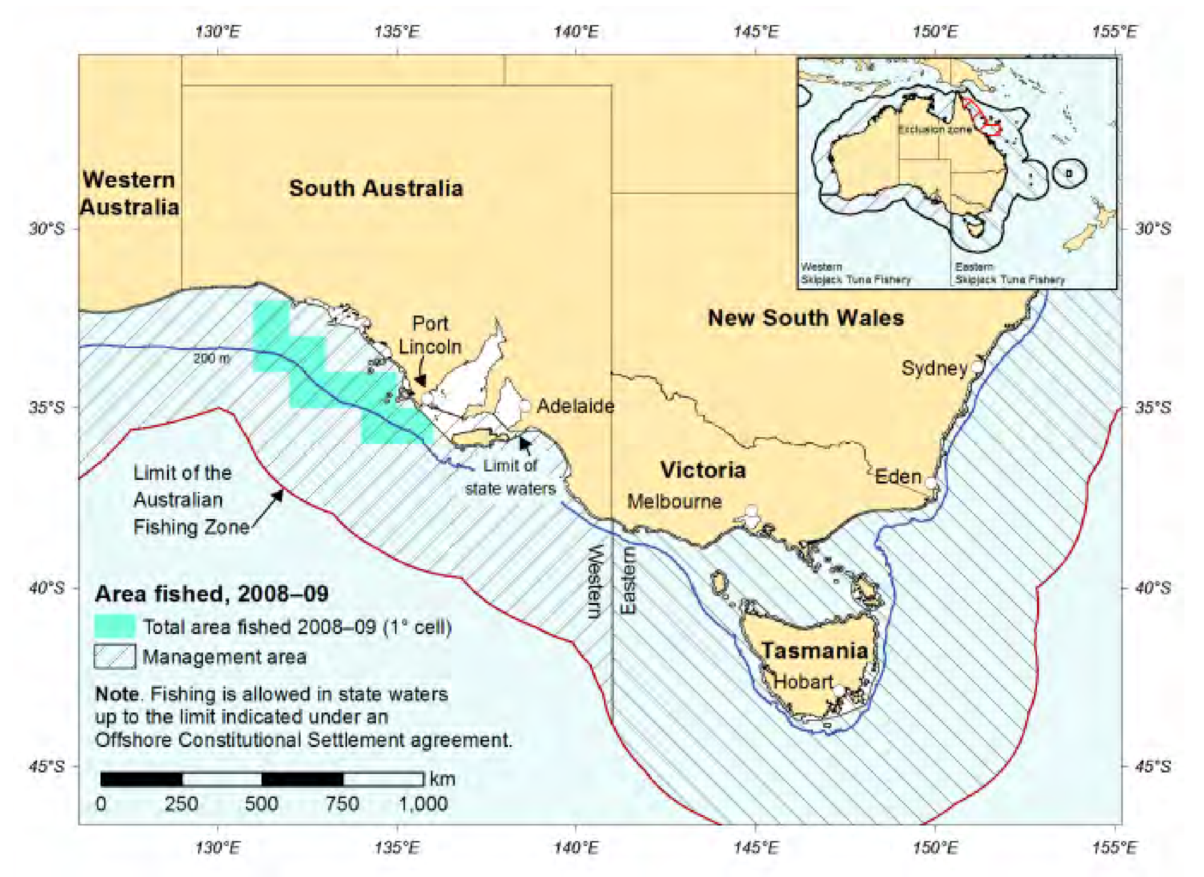


Figure 5.45. Jurisdiction of and fishing intensity in the Commonwealth Eastern tuna and billfish fishery 2018



Last fishing effort occurred in 2008-09.

Figure 5.46. Jurisdiction of and fishing intensity in the Commonwealth eastern skipjack tuna fishery 2008-09

Victorian-managed Fisheries

Victorian-managed commercial fisheries with access licences that authorise harvest in the waters of the spill EMBA include the following:

- Scallop;
- Abalone;
- Rock Lobster;
- Wrasse;
- Ocean Access (General);
- Pipis (the entire Victorian coastline);
- Ocean Purse Seine;
- Inshore trawl; and
- Giant crab.

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), which is presented in Figure 5.47. The activity area overlaps grid cell K12 and covers an area of 0.7855 km^2.

Table 5.21 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.

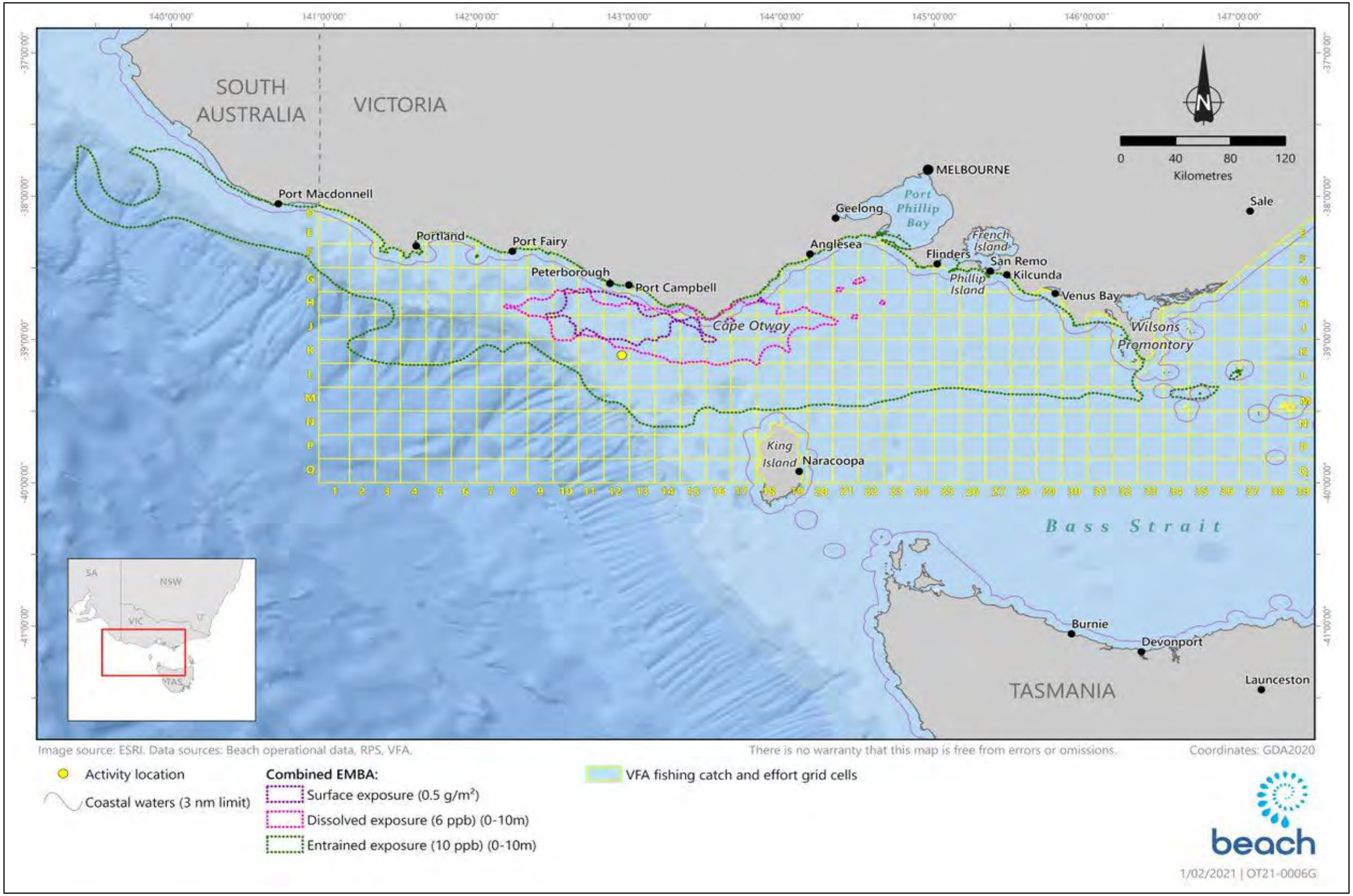


Figure 5.47. VFA fishing catch and effort grid cells overlapped by the activity area and the EMBA

Table 5.21. Victorian-managed commercial fisheries in the EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Giant crab (Western Zone) (Figure 5.48)	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.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.0008% of the fishery. **EMBA?** **Yes.** Fishing is concentrated west of Apollo Bay. The EMBA intersects 34.69% of the fishery.	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 January 2021, there were 11 fishery access licenses.	Catches of giant crab for the last five seasons were: 2018/19 – not available. 2017/18 – 9.8 tonnes. 2016/17 – 10.0 tonnes. 2015/16 – 10.0 tonnes. 2014/15 – 10.5 tonnes.
Rock Lobster Fishery (Figure 5.48)	Southern rock lobster (*Jasus edwardsii*). Very small bycatch of species including southern rock cod (*Lotella* and *Pseudophycis*	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,	**Activity area?** **No.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects	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	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.	The Rock Lobster Fishery is Victoria's most valuable fishery. In the western zone, catches for the last five seasons with available data were: • 2018/19 – 245 tonnes values at $22 million. • 2017/18 – 230 tonnes valued at $18.6 million.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	spp), hermit crab (family *Paguroidea*), leatherjacket (*Monacanthidae spp*) and octopus (*Octopus spp*).	which is a high-current area, facilitating dispersal. •	0.0008% of the fishery. **EMBA?** **Yes.** Fishing is concentrated west of Apollo Bay. The EMBA intersects 34.69% of the fishery.	soft shells increase their vulnerability. Catches generally highest from August to January.	As of July 2020, there were 33 fishery access licences in the eastern zone.	• 2016/17 – 209 tonnes valued at $16.5 million. • 2015/16 – 230 tonnes valued at $19.4 million. 2014/15 – 230 tonnes valued at $19.2 million.
Bass Strait Scallop Fishery (Victorian zone) (Figure 5.49)	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. **EMBA?** **Yes.** Highest fishing effort is concentrated in the eastern waters of the state, with most vessels launching from Lakes Entrance and Port Welshpool. The EMBA intersects	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	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	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. 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.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
			60.36% of the fishery.	increase activity across the fishery.	SESS fishery and the southern squid jig fishery (see Table 5.20).	
Abalone Fishery (Figure 5.50)	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.** The activity area is located within an existing PSZ where fishing is not permitted. The activity area intersects 0.0008% of the fishery. **EMBA?** **Yes.** Based on catch distributed along the Victorian coast. The EMBA intersects 34.69% of the fishery.	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 western zone, catches for the last five seasons were: • 2018/19 – 70 tonnes. • 2017/18 – 63 tonnes. • 2016/17 – 62 tonnes. • 2015/16 – 62 tonnes. • 2014/15 – 56 tonnes. Across all Victorian zones, the catches for the last five seasons with available data were: • 2018/19 – 694 tonnes valued at $31.3 million. • 2017/18 – 756 tonnes valued at $26.9 million. • 2016/17 – 721 tonnes valued at $20.49 million. • 2015/16 – 725 tonnes valued at $19.8 million.
Wrasse Fishery (Figure 5.51)	Blue-throat wrasse (*Notolabrus tetricus*), saddled wrasse (*N. fucicola*), orange-spotted	Entire Victorian coastline out to 20 nm (excluding marine reserves, bays and inlets).	**Activity area?** **No.** There is no overlap between the activity area and the fishery. **EMBA?**	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.	Catches of all wrasse species for the last five seasons were: • 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	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	wrasse (*N. parilus*).		**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. The EMBA intersects 57.72% of the fishery.		As of June 2020, there were 22 fishery access licences.	• 2015/16 – 30 tonnes valued at $627,000. • 2014/15 – 29 tonnes valued at $490,000.
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.** The activity area is located within an existing PSZ where fishing is not permitted. **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).

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Ocean Access (or Ocean General) Fishery	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.** The activity area is located within an existing PSZ where fishing is not permitted. **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.** The activity area is located within an existing PSZ where fishing is not permitted. **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).

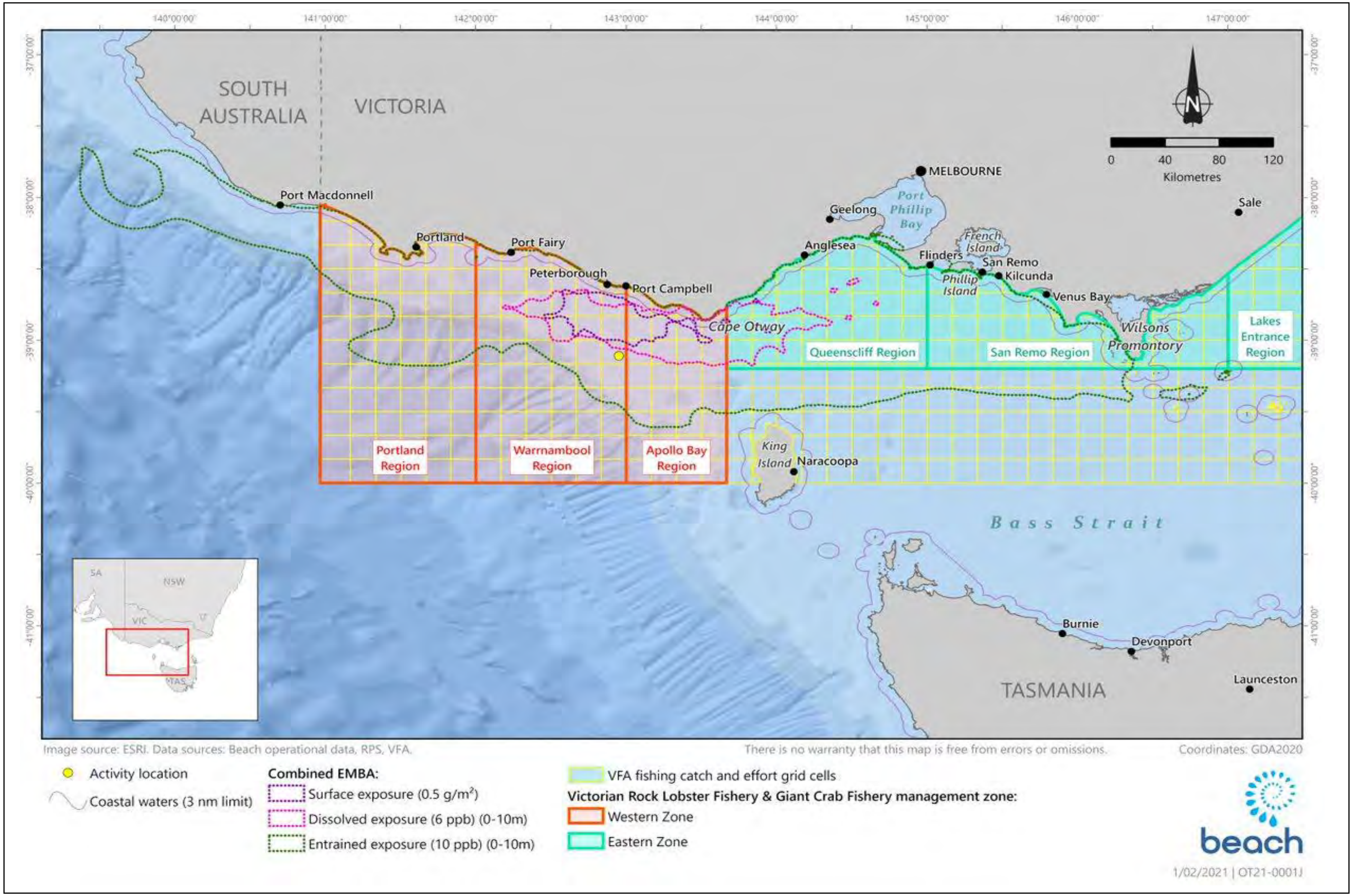


Figure 5.48. Jurisdiction of the Victorian southern rock lobster fishery and giant crab fishery

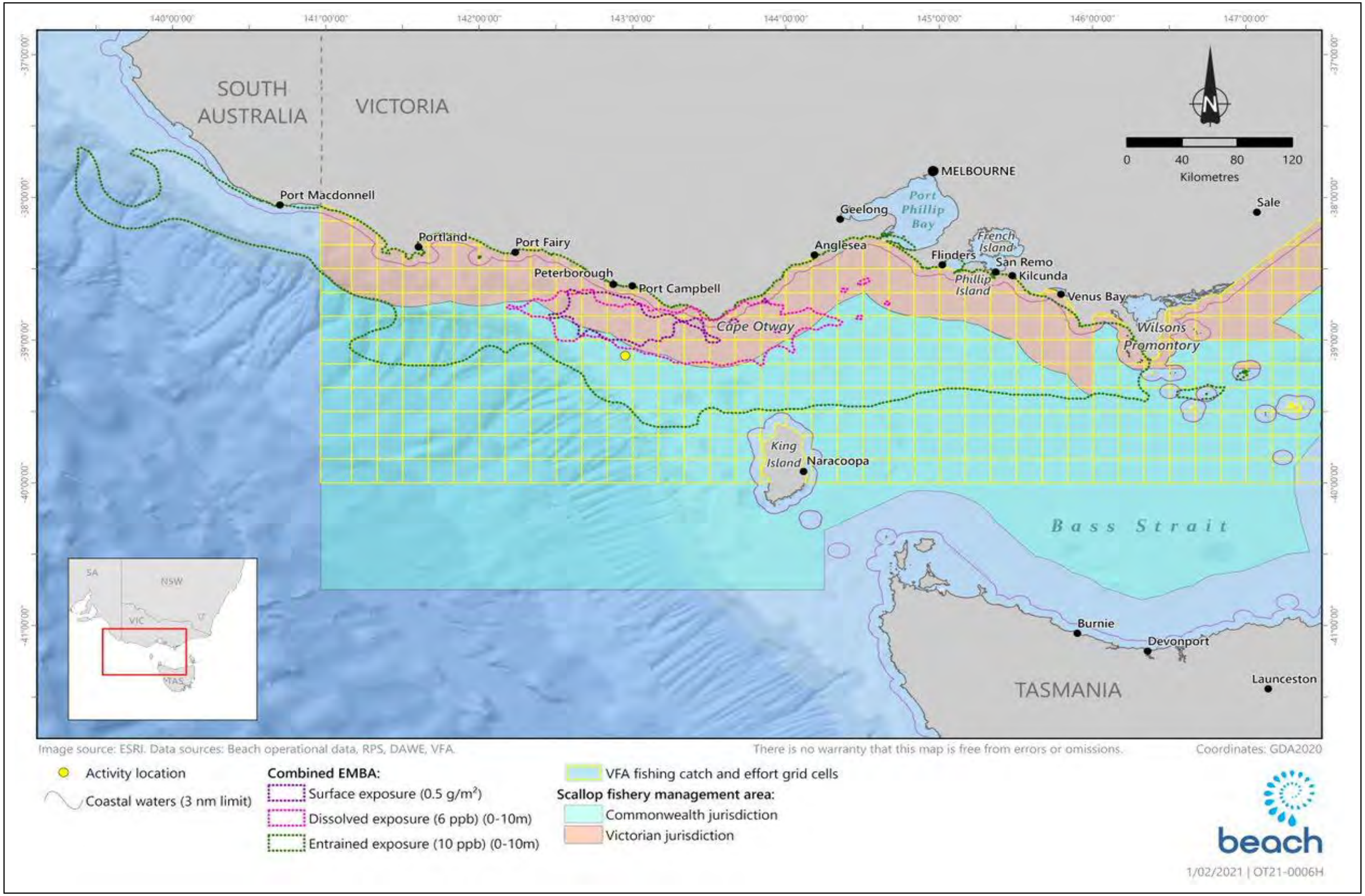


Figure 5.49. Jurisdiction of the Victorian scallop fishery

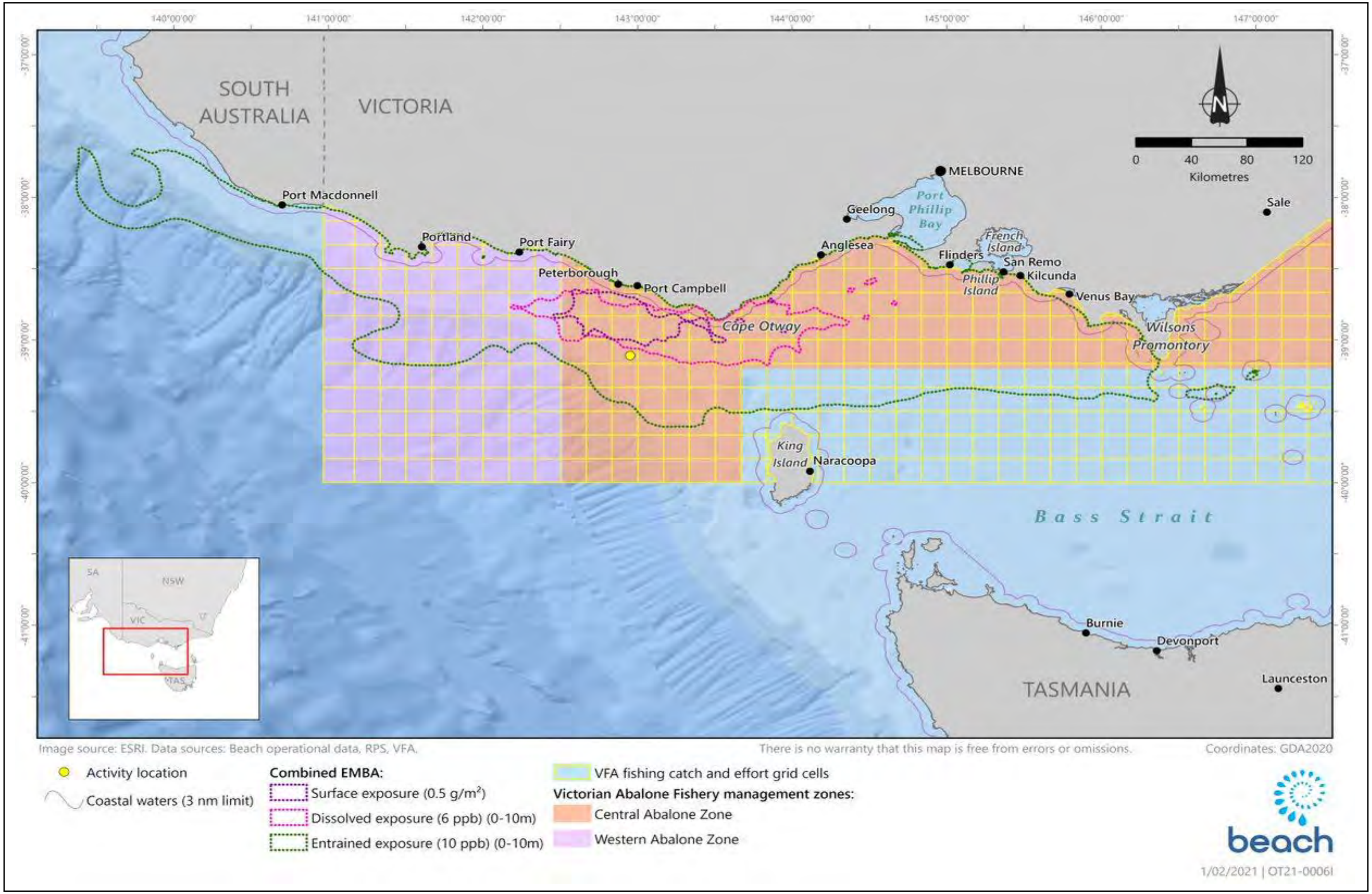


Figure 5.50. Jurisdiction of the Victorian abalone fishery

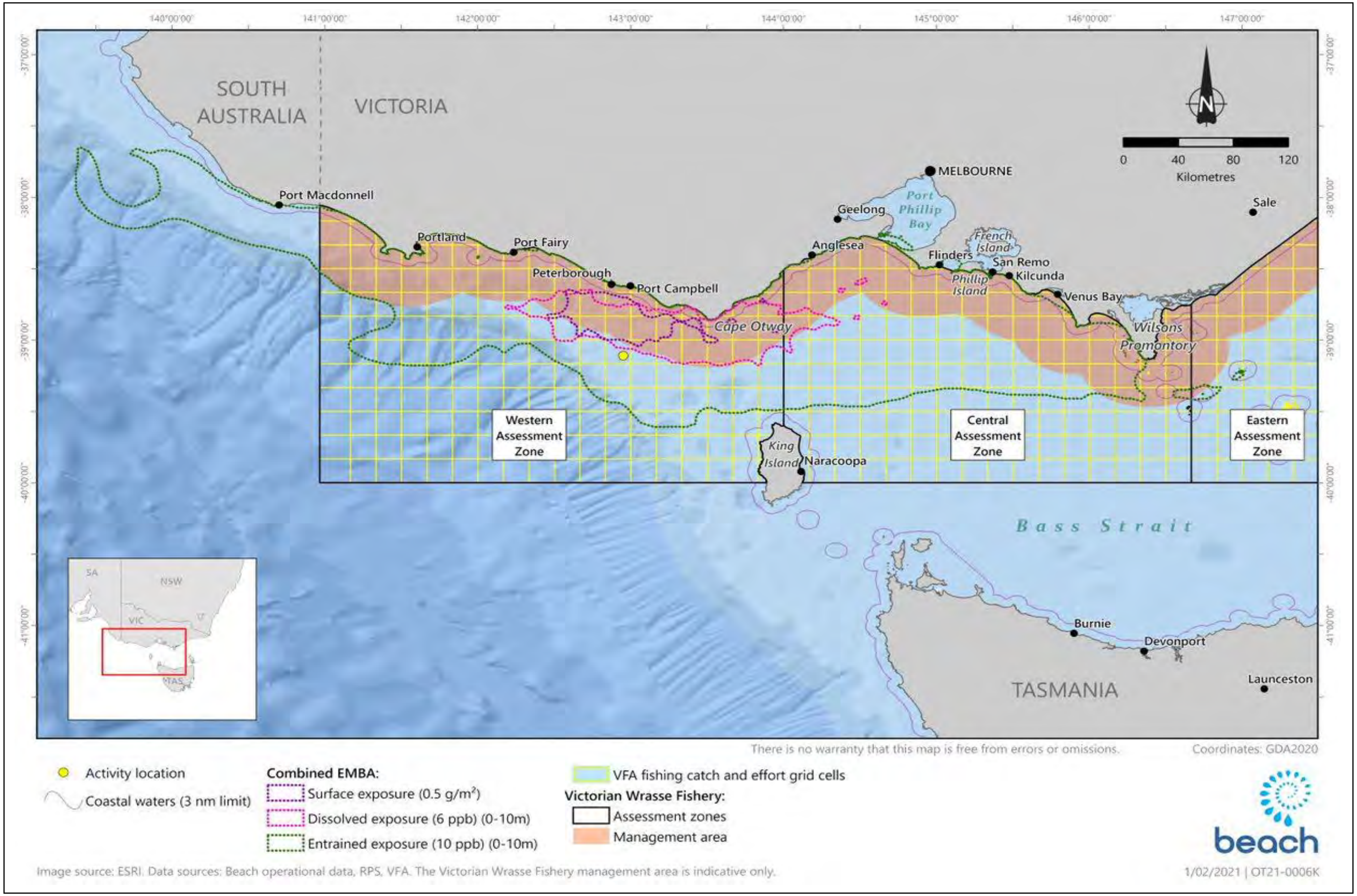


Figure 5.51. Jurisdiction of the Victorian wrasse fishery

Tasmanian-managed Fisheries

Tasmanian-managed commercial fisheries with access licences that authorise harvest in the waters of the spill EMBA include the following:

- Abalone;
- Giant crab;
- Rock lobster;
- Scalefish;
- Scallop;
- Seaweed;
- Shellfish;
- Octopus; and
- Commercial dive.

Table 5.22 summarises the key information for each of these fisheries and indicates that all the above-listed fisheries have jurisdiction to fish in the EMBA but there is no Tasmanian-managed fishing in the activity area.

South Australian-managed Fisheries

South Australian-managed commercial fisheries with access licences that authorise harvest in the waters of the spill EMBA include the following:

- Abalone (southern zone);
- Scalefish;
- Giant crab (southern zone); and
- Rock lobster (southern zone).

Table 5.23 summarises the key information for each of these fisheries and indicates that there is no South Australian-managed commercial fishing in the activity area.

Table 5.22. Tasmanian-managed commercial fisheries in the spill EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Octopus Fishery (Figure 5.52)	Pale octopus (*Octopus pallidus*).	Entire Tasmanian coastline, the fishery shares the same reporting grid as the scalefish fishery (refer to Figure 5.52).	**Activity area? No.** There is no overlap between the fishery and the activity area. **EMBA? Yes.** Catch data reported in the fishery's 2018/19 assessment indicates that fishing activity occurs in the EMBA.	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 5.52)	Multi-species fishery 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.** There is no overlap between the fishery and the activity area. **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.	Catches of key scalefish species for the last five seasons were: • 2017/18 – 318 t. • 2016/17 – 312 t. • 2015/16 – 348 t. • 2014/15 – 273 t. • 2013/14 – 320 t.
Commercial Dive Fishery (Figure 5.53)	Short spined sea urchin (*Heliocidaris erythrogramma*), long spined sea urchin (*Centrostephanus rodgersii*), periwinkles (genus *Turbo*) and Japanese kelp (*Undaria pinnatifida*).	Entire Tasmanian coastline (refer to Figure 5.53).	**Activity area? No.** There is no overlap between the fishery and the activity area. **EMBA? Yes** EMBA intersects the northern reporting zones of the fishery.	1 September – 31 August.	There are currently 52 commercial dive licences.	Historic catch data is not available.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Scallop Fishery	Commercial scallop (*Pecten fumatus*).	Entire Tasmanian coastline	**Activity area? No.** Fishery currently closed for stock assessment. **EMBA? No.** Fishery currently closed for stock assessment.	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.** There is no overlap between the fishery and the activity area. **EMBA? No.** There is no overlap between the fishery and the spill EMBA.	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.	Total state-wide catch of the abalone fishery for the last five seasons (subject to available data) were: • 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.** There is no overlap between the fishery and the activity area. **EMBA? No.** There is no overlap between the fishery and the spill EMBA.	12-month season, from March to February. • Female - 1 May 2018 for all State waters. • Male - 1 September 2018 for all waters south of St Helens around to Sandy Cape. • Male - 1 October	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.	Catches of the rock lobster commercial fishery for the last five seasons (subject to available data) were: • 2018/19 – 1,050 t. • 2017/18 – 1,050 t. • 2016/17 – 1,050 t. • 2015/16 – 1,050 t. • 2014/15 – 1,050 t.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
				2018 all other State waters.		
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.** There is no overlap between the fishery and the activity area. **EMBA? No.** The designated zones occur off the east coast of Tasmania.	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.** There is no overlap between the fishery and the activity area. **EMBA? No.** The primary sites of the fishery occur 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. **EMBA? No.** 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 November 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).

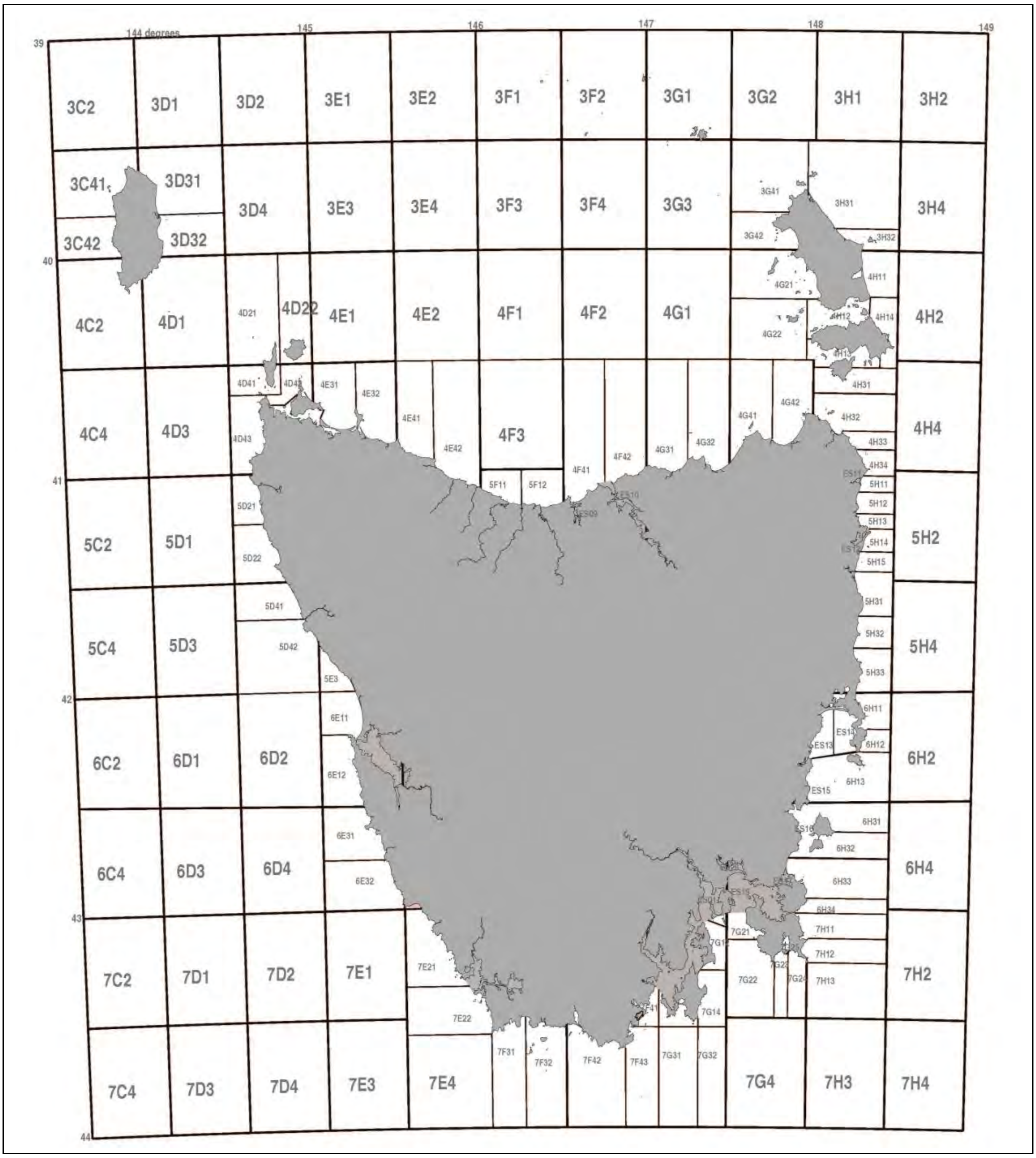


Figure 5.52. Jurisdiction and zones of the Tasmanian Scalefish Fishery and Octopus Fishery

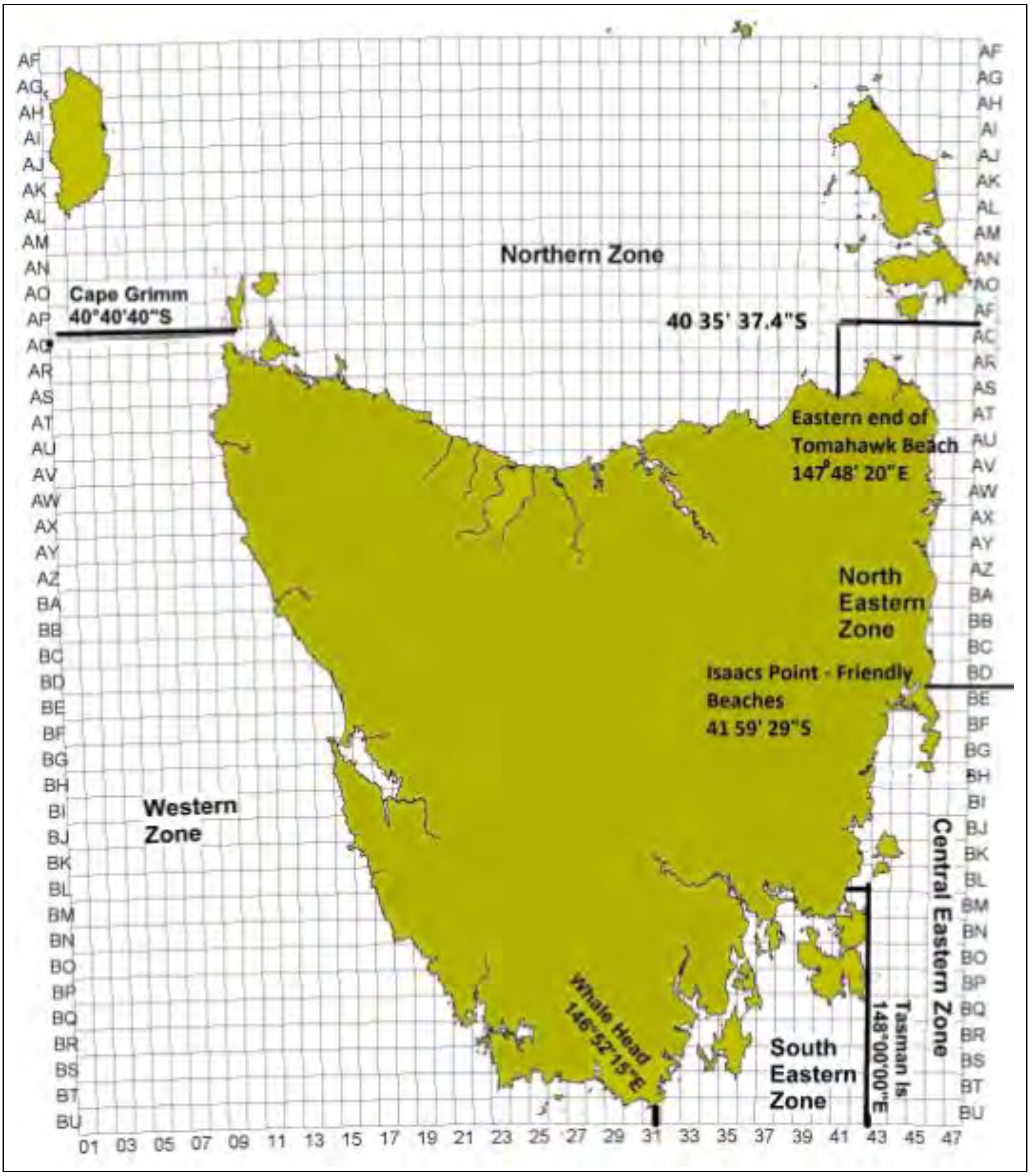


Figure 5.53. Jurisdiction of the Tasmanian Commercial Dive Fishery

Table 5.23. South Australian-managed fisheries

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Abalone (southern zone) (Figure 5.54)	Blacklip (*Haliotis rubra*) and greenlip abalone (*H. laevigata*).	Covers all state waters, divided into southern, central and western zones.	**Activity area? No.** There is no overlap between the activity area and the fishery. **EMBA? Yes.** The spill EMBA intersects the southern one of the fishery.	Assumed year-round.	Abalone inhabit near-shore reefs (5 to 40 m water depth), most abundantly on the leeward side of reefs, and are found in waters with temperatures ranging between 9 and 14°C.	661 tonnes in 2013-14, valued at $22.1 million.
Marine Scalefish (Figure 5.55)	More than 60 species, but the majority of fishing effort (60% by weight) is on four species; King George whiting (*Sillaginodes punctata*), southern garfish (*Hyporhampus melanochir*), snapper (*Pagrus auratus*) and southern calamari (*Sepioteuthis australis*).	All SA waters and out to the edge of the 200 nm AFZ. The deepest waters fished are generally 150 m.	**Activity area? No.** There is no overlap between the activity area and the fishery. **EMBA? Yes.** The spill EMBA intersects the fishery near the state boundary.	Year-round.	A total of 21 different gear types can be registered, with the dominant types being hook and line, haul nets, mesh nets and jigs.	2,324 tonnes in 2013-14, valued at $23 million.
Giant crab (southern zone) (Figure 5.56)	Giant crab (*Pseudocarcinus gigas*)	Covers all state waters, divided into southern, and northern zone.	**Activity area? No.** There is no overlap between the activity area and the fishery. **EMBA? Yes.** The spill EMBA intersects the southern zone of the fishery.	Open between 1 October to 30 April.	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.	TACC was set at 8.7 t for the southern zone in the 2017/18 season. In 2012/13 the fishery was estimated to have a gross value of production of around $690,000.
Rock lobster (southern zone) (Figure 5.57)	Southern rock lobster (*Jasus edwardsii*). Found and fished in waters up to 200 m deep on the continental shelf.	All SA waters out to the edge of the 200 nm AFZ, divided into the Northern Zone (mouth of Murray River to WA border) and Southern	**Activity area? No.** There is no overlap between the activity area and the fishery. **EMBA? Yes.**	Closed between 31 May to 1 October.	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.	1,622 tonnes in 2013-14, valued at $108.8 million.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
		Zone (mouth of Murray River to Victorian border).	The spill EMBA intersects the southern zone of the fishery.		Baited pots are generally set and retrieved each day, marked with a surface buoy.	

Source: PIRSA (2021)

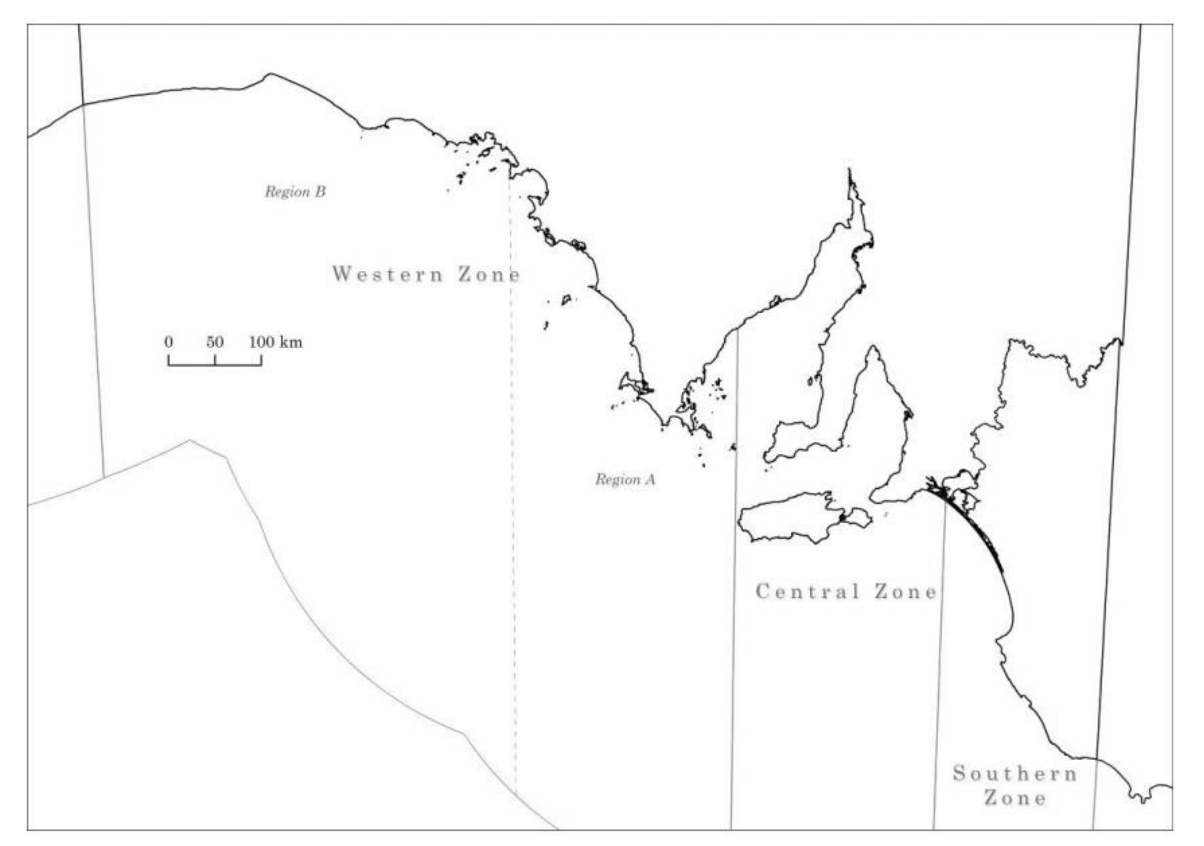


Figure 5.54. Abalone fishery zones

Figure 5.55. South Australian Marine Scalefish Fishery

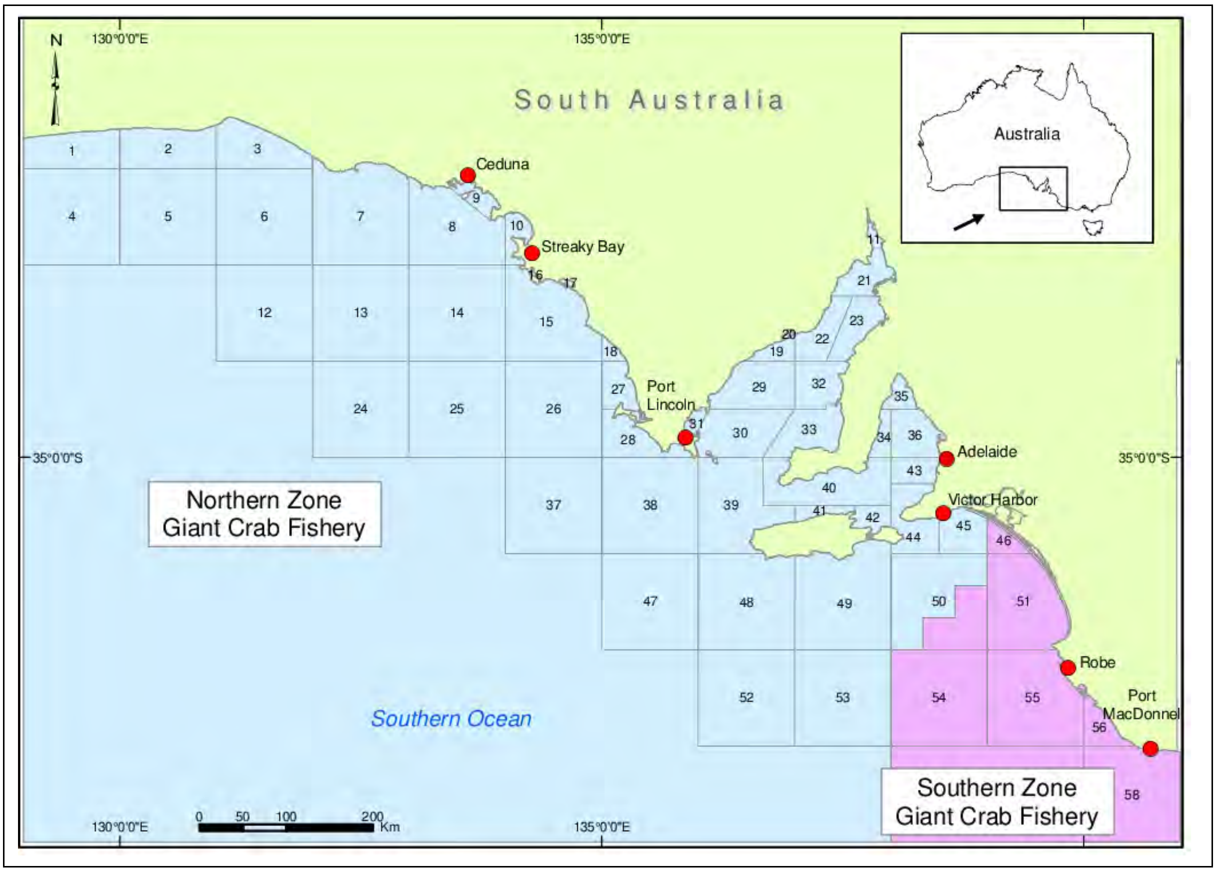


Figure 5.56. South Australia Giant Crab Fishery

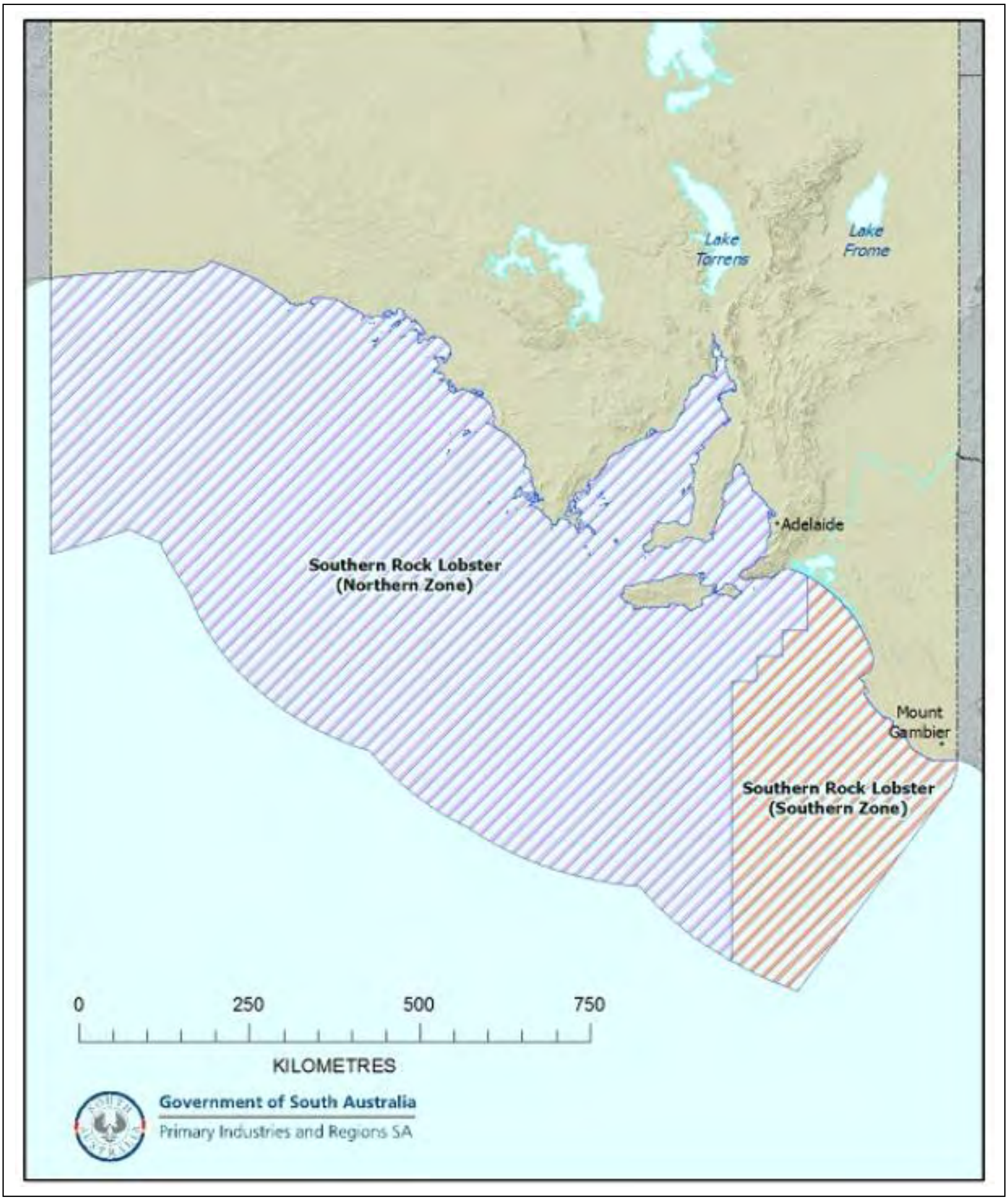


Figure 5.57. South Australia Rock Lobster Fishery zones

5.7.7 Commercial Shipping

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

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 of days of double sailings. The ferry routes are intersected by the EMBA.

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 5.24 and Figure 5.58. This analysis indicates that a total of 1,333 ships passed through this area during 2020. The majority of these (989) are cargo ships, with tankers being the next most frequent (289). On average, 111 vessels pass through or idle within a 20 km radius of the activity area each month.

Table 5.24. Summary of yearly shipping traffic within and adjacent to the activity area (January - December 2020)

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	-	-

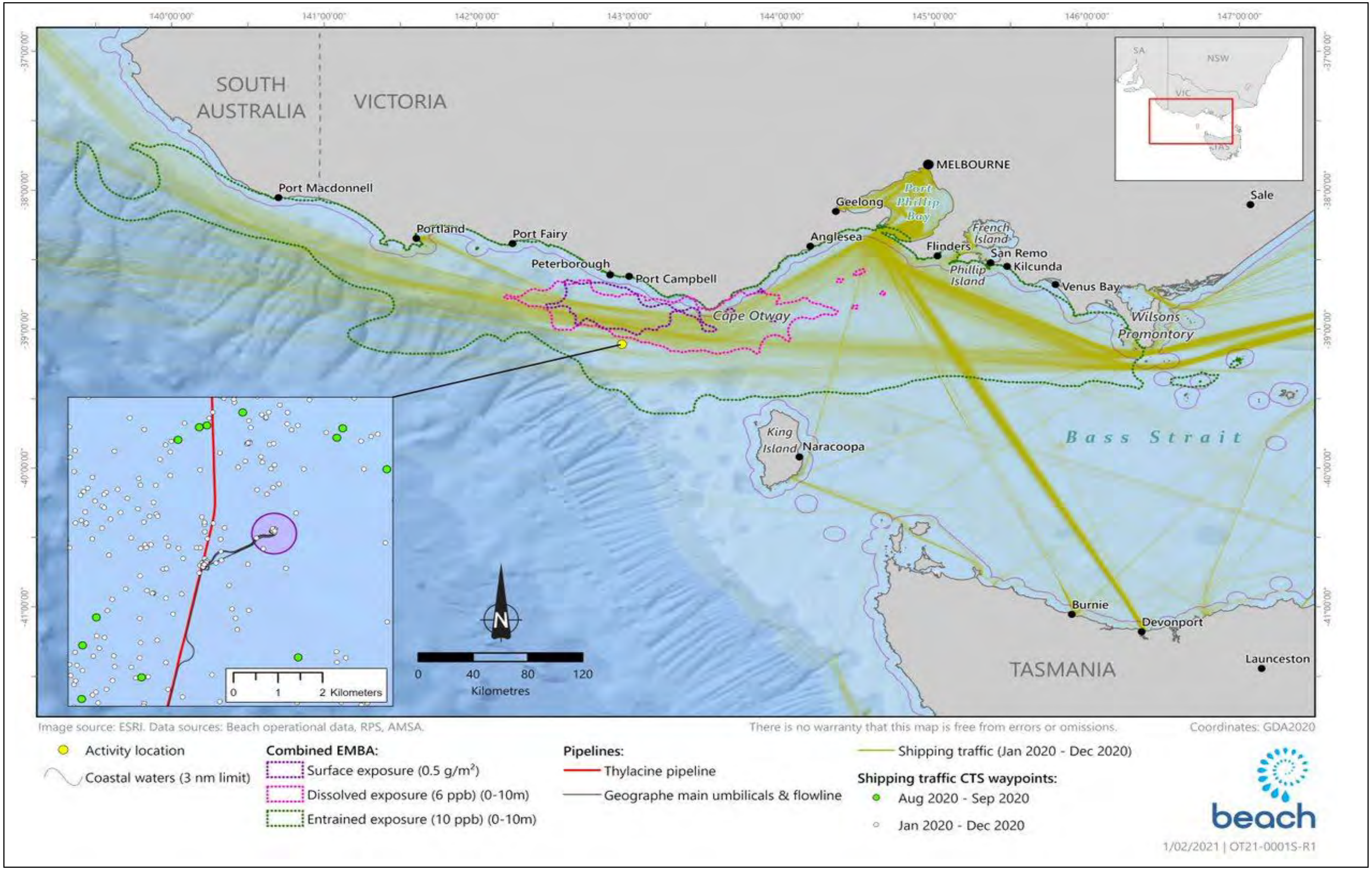


Figure 5.58. Commercial shipping traffic in the activity area and EMBA

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 and risk toolkit for all its activities. This 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 the Beach risk assessment management process, with each step of this process described in this chapter.

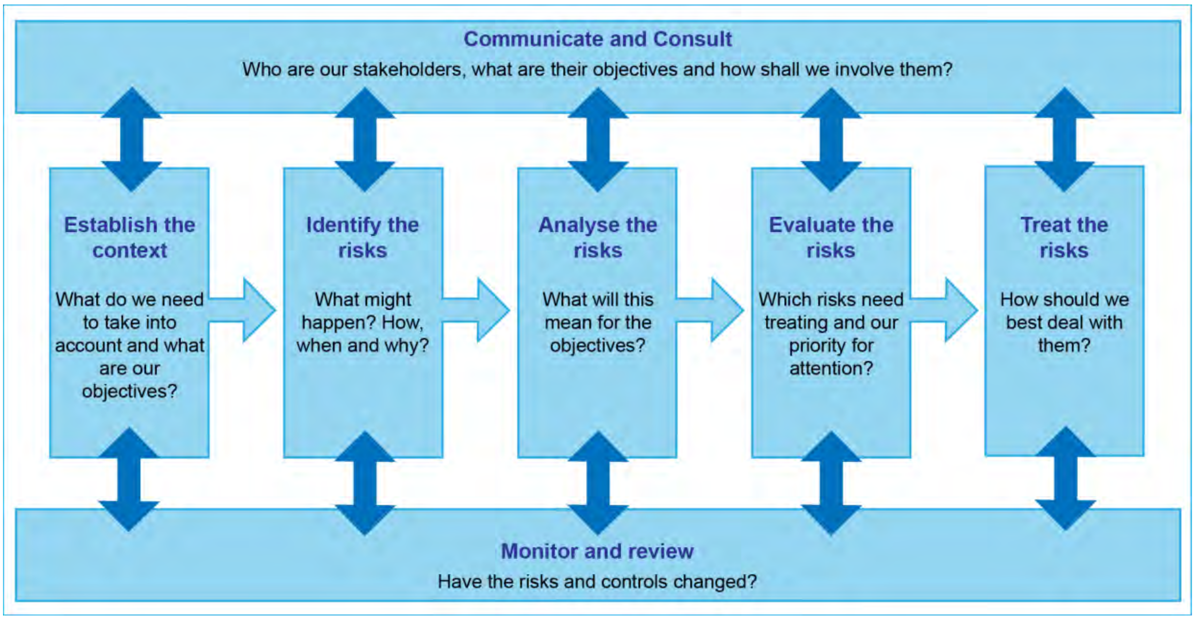


Figure 6.1. Beach risk assessment process

6.1 Step 1 - Communicate and Consult

In accordance with Regulations 11A and 14(9) of the OPGGS(E), Beach has consulted with relevant persons (stakeholders) in the revision of this EP to obtain information about their functions, activities and interests and assess how the activity may impact on these. This information has been used to inform the impact and risk assessment in the EP. The stakeholder consultation process is described in detail in Chapter 4.

6.2 Step 2 - Establish the Content

The first step in the risk assessment process (outlined in Figure 6.1) is to establish the context. This involves:

- 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. This process is described in the following sections.

6.3 Step 3 - Identify the 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 operational 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 accordance with this framework, all risks must be reduced to a level that is considered to be As Low As Reasonably Practicable (ALARP) (see Section 6.3.3).

6.3.1 Definitions

For context, Table 6.1 provides the definitions of impacts and risk according to the OPGGS(E) and international risk management standards.

The OPGGS(E) Regulations 14(5)(6) require that the EP detail and evaluate the environmental impacts and risks for an activity, including control measures used to reduce the impacts and risks of the activity to ALARP and an acceptable level. This must include impacts and risks arising directly or indirectly from all activity operations (i.e., planned events) or potential emergency conditions or incidents (i.e., unplanned events).

In its *Environment plan content requirements* guidance note (N-04750-GN1344, Rev 4, April 2019), NOPSEMA distinguishes between environmental impacts and risks. Environmental impact is defined in Table 6.1 in accordance with the OPGGS(E). Table 6.1 also highlights that environmental risk is not defined in both sets of regulations.

Table 6.1. Definitions of impact and risk

Source	Impact	Risk
OPGGS(E)	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.	Not defined.
ISO AS/NZS 31000: 2018 (Risk management – Principles and guidelines)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 14001: 2016 (Environmental management systems – Requirements with guidance for use)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 4360: 2004 (Risk management)	Not defined.	The chance of something happening that will have an impact on objectives.
HB203: 2012 (Managing environment-related risk)	Any change to the environment or a component of the environment, whether adverse or beneficial, wholly or partly resulting from an organisation's environmental aspects.	The effect of uncertainty on objectives. The level of risk can be expressed in terms of a combination of the consequences and the likelihoods of those consequences occurring.

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, vessel operational discharges (i.e., sewage, putrescible waste, cooling water, etc) will be generated during the activity. and this will have consequences for marine life.
    - For impacts, only a consequence is assigned (likelihood is irrelevant given that the event does occur).
- **Risks** result from **unplanned events** – there *may* be consequences if an unplanned event occurs. Risks are not an inherent part of the activity. For example, a hydrocarbon spill may occur if the 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 (Table 6.2).

6.4 Step 4 – Analyse the Risks

After the impacts and risks have been identified, environmental performance outcomes (EPO) (or objectives) are developed to provide a measurable level of performance for each environmental hazard to ensure that the environmental impacts and risks are managed to be ALARP and acceptable.

Table 6.2. Beach risk assessment matrix

Consequence Rating	Natural Environment	Reputational and/or Community damage / impact / social / cultural heritage	Likelihood of Occurrence					
			Remote (1)	Highly Unlikely (2)	Unlikely (3)	Possible (4)	Likely (5)	Almost Certain (6)
			<1% chance of occurring within the next year. Occurrence requires exceptional circumstances. Exceptionally 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 in 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 possibility it will not. Could occur within months to years.	>50% chance of occurring within the next year. Balance of probability that it 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.
Catastrophic (6)	Long-term destruction of highly valued ecosystem or very significant effects on endangered species or habitats (formally managed).	Irreparable damage of highly valued items or structures of great cultural significance. Negative international or prolonged national media (e.g., 2 weeks).	High	High	Severe	Severe	Extreme	Extreme
Critical (5)	Significant impact on highly valued (formally managed) species or habitats to the point of eradication or impairment of ecosystem. Widespread long-term impact.	Major irreparable damage to highly valued structures/ items of cultural significance. Negative national media for 2 days or more. Significant public outcry.	Medium	Medium	High	Severe	Severe	Extreme
Major (4)	Very serious environmental effects, such as displacement of species and partial impairment of ecosystem (formally managed). Widespread medium and some long-term impact.	Significant damage to items of cultural significance. Negative national media for one day. Adverse attention from non-government organisations (NGOs).	Medium	Medium	Medium	High	Severe	Severe
Serious (3)	Moderate effects on biological or physical environment (formally managed) and serious short-term effects but not affecting ecosystem functions.	Permanent damage to items of cultural significance. Negative State media. Heightened concern from local community. Criticism by NGOs.	Low	Medium	Medium	Medium	High	Severe
Moderate (2)	Minor short-term damage to area of limited significance (not formally managed). Short-term effects but not affecting ecosystem functions.	Some damage to items of cultural significance. Minor adverse local public or media attention and complaints.	Low	Low	Medium	Medium	Medium	High
Minor (1)	No lasting effects. Low-level impacts on biological and physical environment to an area of low significance (not formally managed).	Low level repairable damage to commonplace structures. Public concern restricted to local complaints.	Low	Low	Low	Medium	Medium	Medium

6.5 Step 5 – Evaluate the 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.

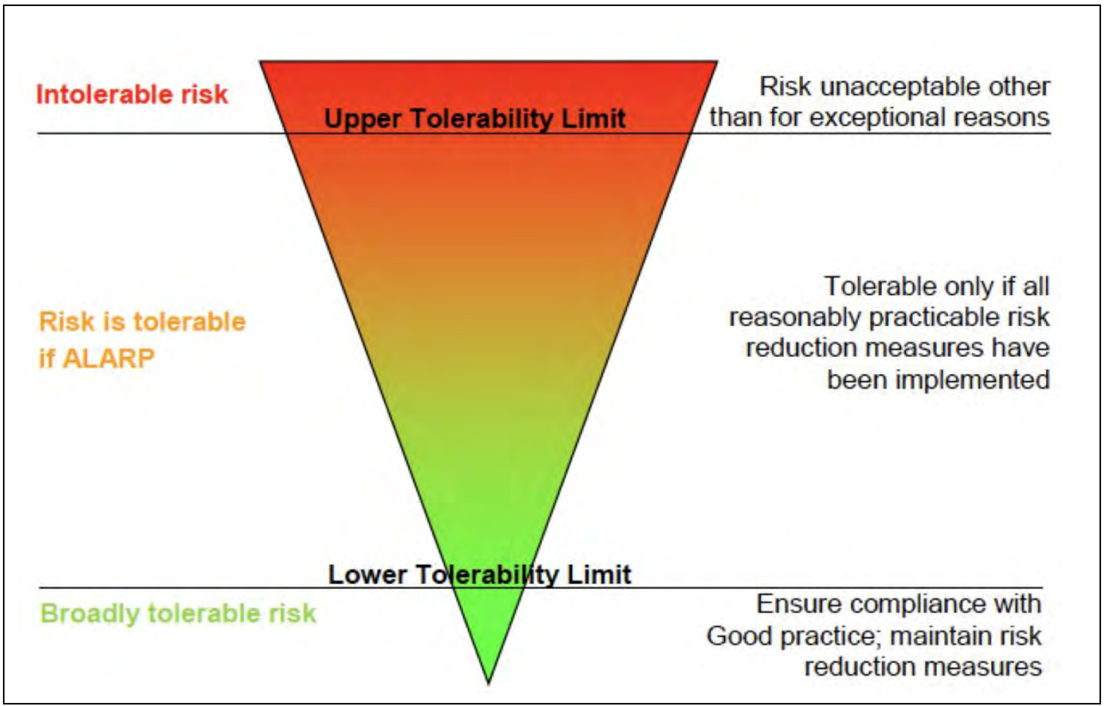
Beach's risk assessment process is described below and was followed in the risk identification and assessment workshop described in Section 6.3:

- Identify and describe the risks (see Chapter 7).
- Determine 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.
- Adopt controls for each impact or risk.

- Undertake an assessment of the consequence of the impact or risk, corresponding to the maximum credible impact across the consequence categories (see Table 6.2, previous page) considering the controls identified and their effectiveness.
- Identify the likelihood of occurrence of those consequences ('remote' through to 'almost certain'), considering the controls identified and their effectiveness, as outlined in Table 6.2.
- For risks, multiply the consequence and likelihood to determine the overall risk raking, outlined in Table 6.2.

6.5.1 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 (GL1721, Rev 6, November 2019) states that in order to demonstrate ALARP, a titleholder must be able to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure.

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)

<table>
<tr><th>Consequence ranking</th><th>Minor</th><th>Moderate</th><th>Serious</th><th>Major</th><th>Critical</th><th>Catastrophic</th></tr>
<tr><td>ALARP level – planned event</td><td>Broadly acceptable</td><td colspan="2">Tolerable if ALARP</td><td colspan="3">Intolerable</td></tr>
<tr><td>Residual impact category</td><td colspan="2">Lower order</td><td colspan="4">Higher order</td></tr>
<tr><td>Risk ranking</td><td>Low</td><td>Medium</td><td>High</td><td>Severe</td><td colspan="2">Extreme</td></tr>
<tr><td>ALARP level - unplanned event</td><td>Broadly acceptable</td><td colspan="2">Tolerable if ALARP</td><td colspan="3">Intolerable</td></tr>
<tr><td>Residual risk category</td><td colspan="3">Lower order risks</td><td colspan="3">Higher order risks</td></tr>
</table>

Hierarchy of Controls

Beach demonstrates ALARP, in part, by adopting the 'Hierarchy of Controls' philosophy (Figure 6.4). The Hierarchy of Controls is a system used across hazardous industries to minimise or eliminate exposure to hazards. The hierarchy of controls is, in order of effectiveness:

- Elimination;
- Substitution;
- Engineering controls;
- Administrative controls; and
- Personal protective equipment (PPE) – this has not been included here as it is specific to the assessment of safety risks rather than environmental management.

Although commonly used in the evaluation of occupational health and safety hazard control, the Hierarchy of Controls philosophy is also a useful framework to evaluate potential environmental controls to ensure reasonable and practicable solutions have not been overlooked.

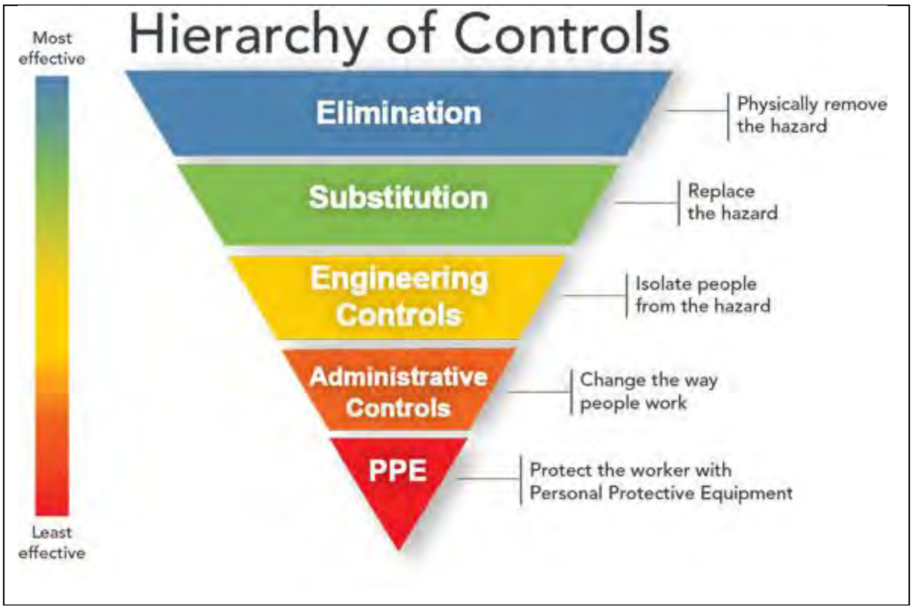


Figure 6.3. The Hierarchy of Controls

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 operational 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 (GL1721, Rev 6, November 2019) is applied.

6.5.2 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 Beach risk matrix (see Table 6.2), the impact consequence is rated as 'minor' or 'moderate' or risks are rated as 'low', 'medium' or 'high' (see also Table 6.3). In these cases, applying 'good industry practice' (see Section 6.5.3) is sufficient to manage the impact or risk to ALARP.

Higher-order Environmental Impacts and Risks

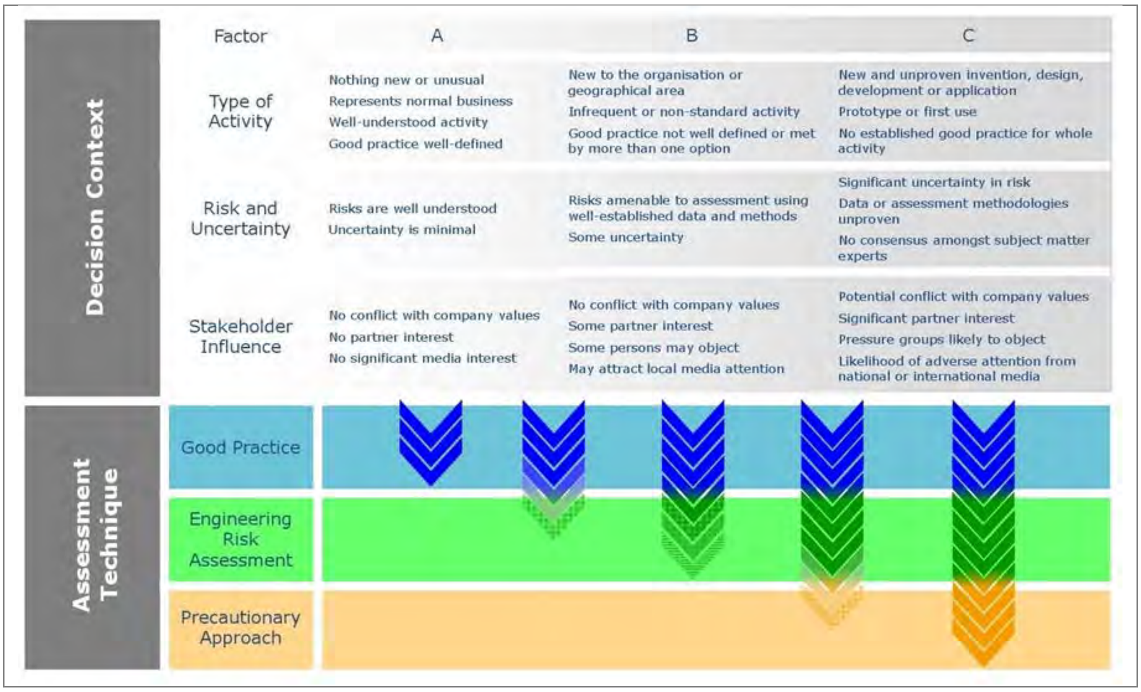
NOPSEMA defines higher-order environmental impacts and risks as those that are not lower order risks or impacts (i.e., where the environment or receptor is formally managed, vulnerable, restricted in distribution, protected or threatened and there is little confidence in the effectiveness of adopted control measures).

Impacts and risks are considered to be higher-order when, using the Beach risk matrix (see Table 6.2), the impact consequence is rated as 'serious', 'major', 'critical' or 'catastrophic', or when the risk is rated as 'severe' or 'extreme' (see also Table 6.3). In these cases, further controls must be considered as per Section 6.5.3.

6.5.3 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.

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.



Source: CER (2015).

Figure 6.4. Impact and risk 'uncertainty' decision-making framework

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.

The decision-making tools outlined in Table 6.4 are explained further below.

Good Practice

In the absence of an Australian definition, the OGUK (2014) and the Irish Commission for Energy Regulation (CER) (2015) define 'Good Practice' as:

> *The recognised risk management practices and measures that are used by competent organisations to manage well-understood hazards arising from their activities.*

NOPSEMA has not endorsed any 'approved codes of practice' or standards to give them a legal status in terms of good practice. Good practice is taken to refer to any well-defined and established standard or codes of practice adopted by an industrial/occupational sector, including 'learnings' from incidents that may yet be incorporated into standards.

Good practice can also be used as the generic term for those standards for controlling risk that have been judged and recognised as satisfying the law when applied to a particular relevant case in an appropriate manner. For this EP, sources of good practice, adapted from CER (2015) are the relevant:

- Commonwealth and state legislation and regulations (outlined in Section 2.2);
- Government policies (outlined in Section 3.5);
- Government guidance (outlined in Section 2.3);
- Industry standards (outlined in Section 2.5 and Section 2.6); and
- International conventions (outlined in Section 2.2.1).

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 (described in Section 6.5.1).

Engineering Risk Assessment

All impacts and risks that require assessment beyond that of good practice (i.e., decision type A) are subject to an engineering risk assessment.

Engineering risk-based tools can include, but are not limited to, engineering analysis (e.g., structural, fatigue, mooring, process simulation) and consequence modelling (e.g., ship collision, dropped object) (CER, 2015). A cost-benefit analysis to support the selection of control measures identified during the risk assessment process may also be undertaken.

Precautionary Principle

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.

6.5.4 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 (GL1721, Rev 6, November 2019) 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 (GL1721, Rev 6, November 2019).

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.
Legislation, industry standard and best practice		

Test	Question	Acceptability demonstrated
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.

6.5.5 Principles of Ecologically Sustainable Development

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 as defined under the EPBC Act and describes how this EP aligns with these principles.

6.6 Step 6 – Treat the Risks

The Geographe subsea installations 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.

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 (EPO), environmental performance standards (EPS) and measurement criteria that are described for each environmental hazard. Monitoring and review are described in detail in the Implementation Strategy (Chapter 8).

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. There is a strong focus in this EP on conserving biodiversity and ecological integrity by understanding the marine environment and commercial fishing activity in and around the operational area (Chapter 5) and implementing controls to minimise impacts and risks (Chapter 7).
E	Improved valuation, pricing and incentive mechanisms should be promoted.	This principle is not relevant to this activity.

7. Environmental Impact and Risk Assessment

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	Minor	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
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

Identifier	Hazard	Inherent	Residual
3	Vessel collision with megafauna	Medium	Low
4	Introduction and establishment of IMS	Medium	Medium
5	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
6	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.

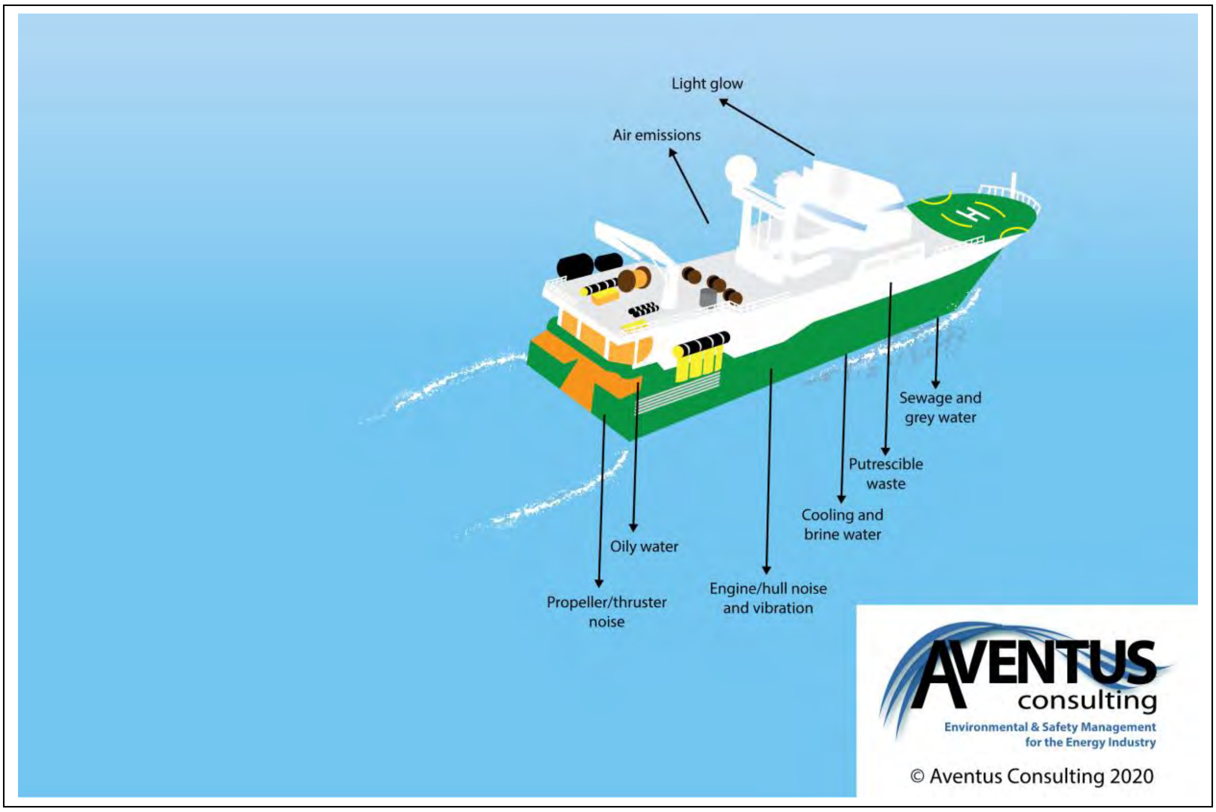


Figure 7.1. Simplified pictorial representation of impacts arising from the activity

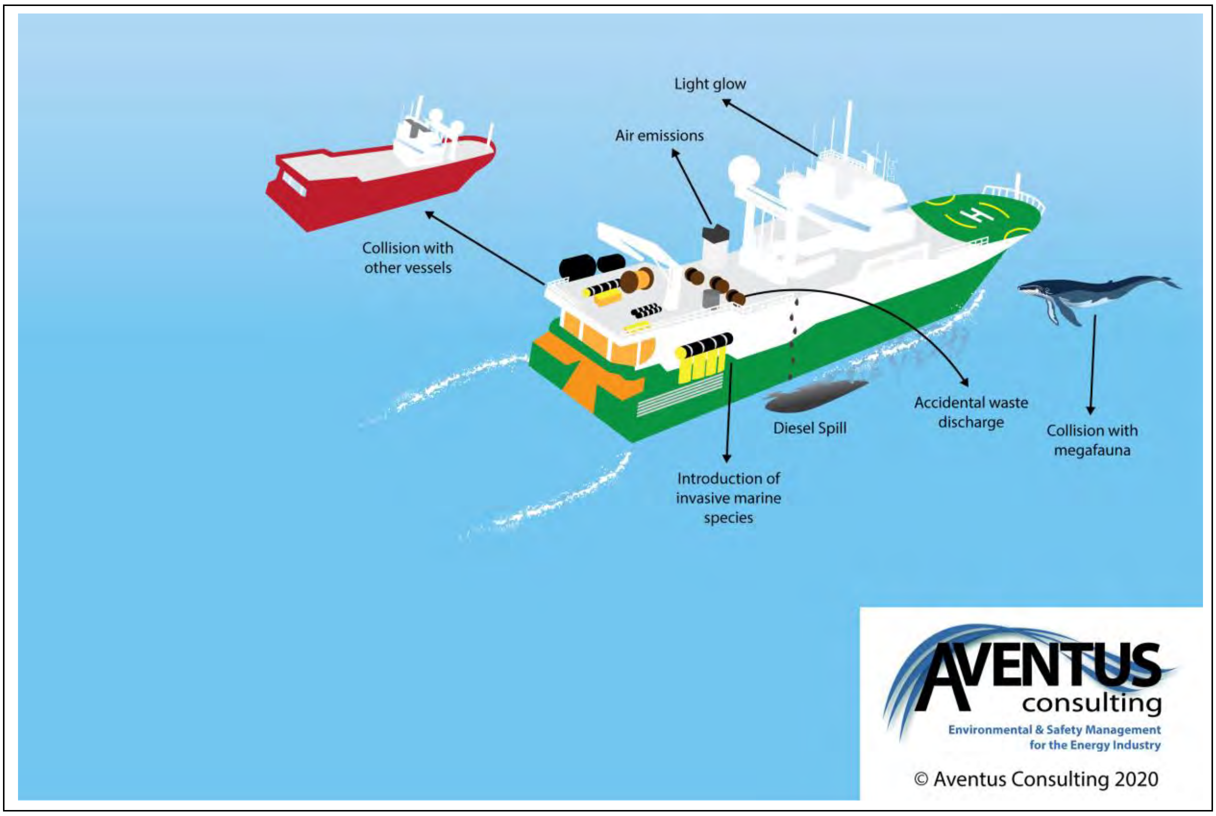


Figure 7.2. Simplified pictorial representation of risks arising from the activity

7.1 IMPACT 1 – Seabed Disturbance

7.1.1 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);
- Temporary set-down of equipment on the seabed (e.g., ROV, tooling baskets, etc);
- Temporary placement of some subsea infrastructure on the seabed prior to repositioning (e.g., production spools); and
- Sediment displacement (e.g., excavation, levelling or water-jetting of seabed sediments to align with infrastructure design criteria).

7.1.2 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.

These impacts will be localised to the activity area (and likely within tens of metres of the installation point) and temporary (hours to days in any one location).

7.1.3 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).

7.1.4 Evaluation of environmental impacts

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 5.3.8, 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 (see Section 5.3.8). The observed habitat supports a diverse infauna dominated by polychaetes, crustaceans and sessile sponges typical of the broader Otway region (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 100 m^2, which in the context of VIC/L23 and the marine bioregion occupies a miniscule area of the seabed. The activity may result in the mortality of sessile fauna within this very small footprint and potentially the mortality of benthic infauna associated with the habitat. However, it is considered that potentially impacted benthic habitats and associated biota are well represented in the region. Therefore, any disturbance and loss of habitat will represent a very small fraction of the widespread available habitat and abundance of benthic fauna in the region. Following removal of the temporarily positioned equipment (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.

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.

7.1.5 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.

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	Stakeholders 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): o 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	There are no guidelines specifically regarding seabed disturbance for offshore activities.

	Exploration and Production (European Commission, 2019)	
	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 (Section 5.5.1)	Localised seabed disturbance will not have any impact on AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Localised seabed disturbance does not have any impacts on Ramsar wetlands.
	TECs (Section 5.5.6)	Localised seabed disturbance will not have any impacts on TECs.
	NIWs (Section 5.5.8)	Localised seabed disturbance will not have any impacts on NIWs.
	Nationally threatened and migratory species (Section 5.4)	Localised seabed disturbance will not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Localised seabed disturbance will not have any impacts on state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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

- 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.

7.2 IMPACT 2 – Underwater Noise Emissions

7.2.1 Hazard

The following activities will generate underwater sound:

- Engine noise transmitted through the hull of the CSV; and
- Propeller and dynamic positioning noise from the CSV.

7.2.2 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).

7.2.3 EMBA

The EMBA (or maximum distance to effect) for underwater sound is based on the results of the Sound Transmission Loss Modelling (STLM), presented throughout this section. Table 7.3 list the distances to behavioural, TTS, PTS, injury for the fauna groups assessed in the STLM.

Table 7.3. Maximum horizontal distances to noise effect criteria from the sound source

Species in the water column	Behavioural	Injury	
		TTS	PTS
Fish (with swim bladders, involved and not involved in hearing)	*	0.06 km	*
Fish eggs and larvae	Near – moderate Intermediate – moderate Far - low	*	*
Cetaceans – low frequency (LFC)		4.56 km	0.13 km
Cetaceans – mid-frequency (MFC)	17.03 km	0.16 km	<0.03 km
Cetaceans – high-frequency (HFC)		2.40 km	0.22 km
Fur-seals (Otariid)		0.03 km	-
Turtles	2 km	0.19 km	< 0.03 km

In accordance with the requirements of the various criteria, only the furthest distance to reach threshold criteria is reported, SEL 24-hr exposure.
- Threshold not reached in the STLM
** No exposure criterion is available to measure against.*

7.2.4 Evaluation of environmental impacts

Ambient sound levels in the Otway Basin have been measured as part of impact assessment activities for the petroleum industry. Acoustic monitoring prior to the development of the Thylacine wells and platform installation (approximately 14 km southwest of the activity area) recorded broadband underwater sound of 93 to 97 dB re 1 µPa (Santos, 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 is 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).

Noise modelling

Jasco Applied Sciences (Jasco) undertook STLM associated with the Beach Energy Otway Development program. The modelling study considered specific components of the program at two representative development well locations; Artisan-1 and Thylacine North-1. The Thylacine North-1 site (located 13 km southwest of the activity area) is considered representative of the activity area due to its similarity in seabed characteristics, water depth and environmental regime (Matthews *et al*., 2020). Therefore, the STLM results for this site have been applied to this activity and this section only details information pertaining to the modelling undertaken at the Thylacine North-1 site. The STLM report is available in Appendix 7.

The study considered separate scenarios of a large pipelaying and CSV holding station using DP and making headway while laying pipe. Given the nature of the activities under this EP, only the scenarios relating to the vessel being stationary using DP are assessed. The modelling assessed distances from operations where underwater sound levels reached exposure criteria corresponding to various levels of potential impact to marine fauna. The marine fauna considered was based on a review of receptors that may be impacted by continuous noise (as per Table 7.3). The exposure criteria selected for the modelling and the impact assessment were selected as they have been accepted by regulatory agencies and because they represent current best available science (Matthews *et al*., 2020). Two scenarios were modelled that are most representative of this activity. The scenarios represent a large construction vessel operating under DP at two different Maximum Continuous Ratings (MCR; 20% and 40%) while stationary for a period of 24 hours during the installation of subsea infrastructure. The relevant scenarios modelled are detailed in Table 7.4.

Table 7.4. Acoustic modelling scenarios

Scenario	Description
1	CSV stationary under DP, operating at 20% MCR
2	CSV stationary under DP, operating at 40% MCR

The Beach Energy Otway Development may utilise several different vessels to complete the works, which include pipelaying activities not covered in this EP. Vessels considered representative of that to be used for this activity, along with the total installed power of their propulsion systems, include the *Seven Vega* (18,800 kW), *Seven Oceans* (15,850 kW), *Deep Energy* (21,500 kW), or *Deep Blue* (25,600 kW). The TechnipFMC pipelay vessel *Deep Blue* was considered for the modelling as it has the greatest installed total propulsion power. In the absence of vessel-specific operational data, and no clear trend in vessel operations being available, it was assumed that all thrusters, including retractable azimuth and tunnel thrusters, are operational during DP. Given that this activity does not include pipelaying, it is likely that the CSV used for this activity will be smaller and have a lower propulsion power than a specialised pipelaying vessel. Thus, these results are considered conservative for the Geographe subsea installation activities.

Fish

Popper et al (2014) details that there is no direct evidence of mortality or potential mortal injury to fish from ship noise. Popper et al (2014) details that risks of mortality and potential mortal injury, and recoverable injury impacts to fish with no swim bladder (sharks) or where the swim bladder is not involved in hearing is low and that TTS in hearing may be a moderate risk near (tens of metres) the vessel. For fish with a swim bladder involved in hearing, risks of mortality and potential mortal injury impacts is low. However, some evidence suggests that fish sensitive to acoustic pressure show a recoverable loss in hearing sensitivity or injury when exposed to high levels of noise. Popper et al (2014) details sound pressure level criteria for fish with a swim bladder involved in hearing, which is presented in Table 7.5 along with the modelled distances to effect.

Table 7.5. SPL criteria for fish with a swim bladder involved in hearing and modelled distances to effect

Fish: swim bladder involved in hearing	**SPL (L_p; dB re 1 µPa)**	**PLV at 20% MCR (Scenario 1)**	**PLV at 40% MCR (Scenario 2)**
		R_{max} (km)	R_{max} (km)
Recoverable injury	170 dB SPL for 48 hrs	<0.03	<0.03
TTS	158 dB SPL for 12 hrs	0.05	0.06

No impacts are expected, as there are not likely to be site-attached fish permanently present in the activity area given the absence of hard substrate in the activity area. The 48-hr recoverable injury criteria was only reached within 30 m of the CSV. 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 30 m of the CSV. Thus, recoverable injury impacts are not predicted.

The 12-hr TTS criteria is predicted to only be reached within 60 m of the CSV. 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 60 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*) (DSEWPaC, 2013a) does not identify noise as a threat.

No commercial fishing takes place within the activity area (due to the 500-m radius PSZ around the existing Geographe wells). Thus, impacts to commercial fisheries are not predicted.

The consequence of the CSV being on location for up to 30 days is assessed as 'minor' for fish based on:

- The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 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.
- Commercial fishing is not permitted within the activity area.

<u>Turtles</u>

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) identifies noise interference as a threat to turtles. It details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat.

Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to sea turtles from ship noise.

There are currently no quantitative exposure guidelines or criteria for turtles for continuous sound such as those generated by the construction vessel. Popper et al (2014) found that there was insufficient data available and instead suggested general distances to assess potential impacts. Using semi-quantitative analysis, Popper et al

(2014) suggests that there is a low risk to marine turtles from shipping and continuous sound except for TTS near (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. The furthest distance to the PTS criteria for turtles is <30 m and the furthest distance to the TTS criteria is 190 m (Matthews *et al*., 2020). These distances do not extend beyond the activity area. This means there will be no overlap in ensonified sound areas from both activities taking place concurrently.

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 (DoE, 2017a) 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 30 m and 190 m, respectively, of the CSV and drilling support vessels. 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, where no important turtle habitat is located.
- Low numbers of turtles are predicted in the activity area and therefore impacts would be limited to a small number of individuals and not at the population level.

Marine Mammals (PTS and TTS)

The US National Marine Fisheries Service (NMFS 2018) reviewed available literature to determine exposure criterion for TTS and PTS for marine mammals based on their frequency hearing range. NFMS (2018) details that after sound exposure ceases or between successive sound exposures, the potential for recovery from hearing loss exists, with PTS resulting in incomplete recovery and TTS resulting in complete recovery.

The NFMS (2018) exposure criteria are based on a cumulative sound exposure levels over a period of 24 hours. Table 7.6 details the criteria and modelled distances to them.

The PTS and TTS 24 h criteria are only relevant to those receptors that are likely to be present in the area of ensonification for a period of 24 h. For this assessment the PTS and TTS 24-hr criteria were applied to marine mammals that may be undertaking biologically important behaviours, such as calving, foraging, resting or migration (as defined by DoE, 2015d), that could result in them being within the ensonification area above the PTS and TTS criteria for a period of 24-hr or greater.

Table 7.6. PTS and TTS noise criteria for sensitive receptors and predicted distances and areas

Hearing group	Frequency-weighted SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	Vessel stationary, at 20% MCR (Scenario 1)		Vessel stationary, at 40% MCR (Scenario 2)	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS					
LFC	199	0.08	0.02	0.13	0.06
MFC	198	-	-	<0.03	<0.03
HFC	173	0.13	0.05	0.22	0.13

Hearing group	Frequency-weighted SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	Vessel stationary, at 20% MCR (Scenario 1)		Vessel stationary, at 40% MCR (Scenario 2)	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
Phocid seals	201	<0.03	<0.01	<0.03	<0.01
Otariid seals	219	-	-	-	-
Turtles	220	<0.03	<0.01	<0.03	<0.01
TTS					
LFC	179	2.66	15.21	4.56	40.24
MFC	178	0.09	0.02	0.16	0.07
HFC	153	1.67	6.95	2.40	14.40
Phocid seals	181	0.36	0.30	0.52	0.75
Otariid seals	199	<0.03	<0.01	0.03	<0.01
Turtles	200	0.12	0.04	0.19	0.10

Note: a dash indicates the level was not reached within the limits of the modelling resolution (25 m).

Phocid seals

The furthest distance to phocid (earless) seal PTS criteria is <30 m and the furthest distance to TTS criteria is 520 m. No phocid seals are identified in the PMST report for the activity area (approximately the area of TTS ensonification) and therefore they are not assessed further.

Otariid seals

The otariid seal PTS criteria was not reached and the furthest distance to the TTS criteria is <30 m. The PMST report for the activity area identified the Australian and New Zealand fur-seals, however, no BIAs or behaviours (such as breeding colonies) are identified within the area of ensonification and therefore they are not assessed further.

High-frequency cetaceans

The furthest distance to the HFC PTS criteria is 220 m and the TTS criteria is 2.40 km. The PMST report for the activity area (including a 3 km buffer) does not identify any HFC such as pygmy and dwarf sperm whales, therefore they are not assessed further.

Mid-frequency cetaceans

The furthest distance to the MFC PTS criteria is <30 m and the TTS criteria is 160 m. The PMST report for the activity area does not identify any MFC, therefore they are not assessed further.

Low-frequency cetaceans

The furthest distance to the LFC PTS criteria is 80 m and the further distance to the TTS criteria is 4.56 km. Table 7.7 lists the LFC that have BIAs or biologically important behaviours, which were identified from the PMST report for the activity area and maximum distance to TTS criteria. The southern right whale core coastal range is within the ensonification area above the PTS and TTS criteria, though this is not a BIA and no biologically important behaviours (such as breeding and calving) are known to occur in this area. The southern right whale has been included in this assessment as a conservative measure and for completeness.

Table 7.7. Marine mammal species with biologically important behaviours within the PTS and TTS ensonification area

Species	Biologically Important Behaviour
Blue whale	Foraging, feeding or related behaviour known to occur within area.
	Foraging BIA
Fin whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs
Pygmy right whale	Foraging, feeding or related behaviour may occur within area.
	No BIAs
Sei whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs

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 5.4.5, cetacean foraging within the Otway shelf, and hence the area where the PTS and TTS criteria is reached, is typically from January to April. This foraging period is outside the timing of this activity (July to October) and pygmy blue whales are unlikely to be foraging in the area at this time of year. However, the presence of LFC on the Otway shelf spans most months of the year (see Figure 5.15).

The Conservation Management Plan for the Blue Whale (DoE, 2015d) states that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury. The conservation plan identifies shipping and industrial noise as a threat that is classed as a minor consequence, which is defined as 'affects at an individual level but not affects at a population level'. The conservation plan details that given the behavioural impacts of noise on pygmy blue whales are largely unknown, a precautionary approach has been taken regarding assignation of a minor consequence rating.

The area of impact regarding underwater sound is small in this scenario. The STLM predicts that the furthest distance to the TTS criteria is 4.56 km. At any one time, the largest area of impact would be 40.24 km^2, which equates to approximately 0.23% of the pygmy blue whale high density foraging BIA (35,627 km^2). Furthermore, given the activity timing is July-October and pygmy blue whales typically forage in the area from January-May, individuals of this species are highly unlikely to be foraging within the ensonified area at the time of the activity (see Section 5.4.5).

The southern right whale core coastal range is within the ensonified area above the TTS criteria. As detailed in Section 5.4.5, there is the potential for southern right whales to be transiting through the area during May-June and September-November, the latter period overlaps the scheduled timing for this activity (July-October). The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise as a threat that is classed as a minor consequence, as defined earlier. The conservation plan states that given the behavioural impacts of noise on southern right whales are largely unknown, a precautionary approach has been taken regarding assignation of a minor consequence rating. Given that the closest distance to the identified areas of southern right whale biologically important behaviours (such as calving, foraging, resting or migration) occurs 39 km from the activity area, TTS and PTS are not assessed for these areas as impacts are not predicted. Regarding its core coastal range, the area of impact is small with the furthest distance for the TTS criteria being 4.56 km. At any one time the largest area of impact would be 40.24 km^2, which equates to 0.04% of the southern right whale current core coastal range (217,825 km^2).

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 biologically important areas) of sei whales is further defined, an assessment of the impacts of increasing anthropogenic noise (including from seismic surveys, port expansion, and coastal development) should be undertaken on this species.
- If required, additional management measures should be developed and implemented to ensure the ongoing recovery of sei whales.

The 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'-'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 area of impact is small, with the furthest distance for the TTS criteria being 4.56 km. At any one time the largest area of impact would be 40.24 km^2, which equates to 0.002% of the Western Bass Strait Shelf Transition provincial bioregion.

The TTS and PTS impacts to LFC are assessed as minor and are of an acceptable level based on:

Blue whales

- Blue whale presence in the Otway region is temporally limited to November-May, with foraging in the ensonified area most likely during January-April. Therefore, blue whales are unlikely to be present or foraging in the ensonified area during the activity (July-October).
- A conservative approach has been taken in applying the STLM results to this activity due to the use of a vessel propulsion system that is likely to be larger than the one ultilised for this activity.
- Adopted controls as detailed in Section 7.2.5 will prevent possible PTS or TTS impacts to whales that may be undertaking biologically important activities in the ensonified area.
- The Conservation Management Plan for the Blue Whale (DoE, 2015d) details that shipping and industrial noise are classed as a 'minor' consequence and therefore impacts may be at the individual level but not at a population level.
- The Conservation Management Plan for the Blue Whale (DoE, 2015d) 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 the noise generated from the CSV 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 if present.
- Though blue whales are unlikely to be present in the high-density foraging BIA when the activity is taking place, the largest area of potential impact within the BIA is very small at 0.23% for TTS and 0.003% for PTS of the BIA.
- The TTS ensonification area is approximately 95 km southeast of the Bonney Coast Upwelling KEF, which is a known feeding and aggregation area for blue whales (Gill *et al.*, 2011; McCauley *et al.*, 2018) and based on the

occurrence of an upwelling event between 2002 and 2016 the KEF has an upwelling frequency of 30 – 50%, which is classed as seasonal (Huang and Wang, 2019). The TTS ensonification area is within an area with a historical frequency of <10% of an upwelling occurring (Huang and Wang, 2019).

- 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).
- Blue whales are usually solitary but are occasionally found in small feeding aggregations where krill is abundant (DSE, 2009).

Southern right whales

- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) details that shipping and industrial noise, are classed as a minor consequence and therefore impacts may be at the individual level but not at a population level.
- Though the activity may be conducted during the period when southern right whales are within the core coastal range, the area of potential impact is very small (0.04%) compared to the large area of the southern right whale core coastal range.
- There is no overlap between the PTS and TTS criteria and southern right whale BIAs where biologically important behaviours such as calving, foraging, resting or migration occur (as defined by DoE, 2015d).
- Southern right whales' movements are unlikely to be restricted as they are not undertaking biologically important behaviours within the area where the TTS noise criteria is reached.
- Low numbers of southern right whales are predicted based on aerial surveys in the Otway region (2002 – 2013), which recorded 12 groups of southern right whales 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.

Other low-frequency cetaceans

- 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'-'large'.
- The pygmy right whale SPRAT database (DAWE, 2020b) (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 TTS ensonification area based on the following:
    - The TTS ensonification area is ~95 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).
    - No BIAs are identified for these species.
    - Aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of 8 individuals, 12 sei whale sightings consisting of 14 individuals and one pygmy right whale sighting consisting of 100 individuals (Gill *et al*., 2015).
    - 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.

<u>**Marine mammals (behaviour)**</u>

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.

While the activity is underway, the noise generated will be heard above background levels (90 to 110 dB re 1 µPa (McCauley, 2004)), which is predicted to be >75 km based on the STLM (Matthews *et al*., 2020). However, marine mammals are expected to continue to use areas of the environment exposed to higher levels of noise than background levels. For example, blue whales are known to continue foraging and feeding when exposed to noise above background levels, as evidenced by ongoing sightings in their foraging area alongside shipping and industrial noise sources in the ocean. The Conservation Management Plan for Blue Whales (DoE, 2015d) states that the need to feed can override the need to move away from a possible threat such as anthropogenic noise. Therefore, marine mammal behaviour is expected to continue as normal once the activity is underway. For this reason, behavioural impacts to marine mammals are not assessed further for the time when the activity is underway.

The NFMS (NOAA, 2019) behavioural criteria and predicted distance for each scenario is detailed in Table 7.8. The furthest distance of 17.03 km has been used to define the noise behaviour EMBA to identify potential receptors. The distance of 17.03 km is only predicted when the CSV is stationary using DP at 40% MCR (Scenario 2). At 20% MCR (Scenario 1), the furthest distance to behavioural criteria is 11.18 km. Therefore, use of the 17.03 km distance is considered highly conservative for this activity.

Table 7.8. Marine mammal behavioural noise criteria and predicted distances

SPL (L_p; dB re 1 µPa)	**PLV at 20% MCR (Scenario 1)**	**PLV at 40% MCR (Scenario 2)**
	R_{max} (km)	R_{max} (km)
120	11.18	17.03

Within the EMBA for marine mammal behaviour response, the following have been identified:

- Nineteen whale species, seven dolphin species and two fur-seal species may be present based on the PMST report.
- Foraging behaviour for the blue whale (known to occur), fin whale (likely to occur), pygmy right whale (may occur) and sei whale (likely to occur). As detailed in Section 5.4.5, cetacean foraging within the Otway shelf, and hence within the noise behaviour EMBA, is typically from January to April, which is outside the activity timing (July-October). As such, behavioural impacts to feeding blue whales are not expected for this activity.
- Southern right whale core coastal range. As detailed in Section 5.4.5, southern right whales move through the area during May-June and September-November. The activity timing overlaps with the timing when southern right whales move towards coastal aggregation and migration areas.
- No habitats critical to the survival of the species are identified.

The Conservation Management Plan for the Blue Whale (DoE, 2015d) details that anthropogenic noise in BIAs will be managed such that any blue whale is not displaced from a foraging area. The conservation plan details that shipping and industrial noise are classed as a 'minor' consequence where individuals are affected but there is no affect at a population level. The conservation plan states that given the behavioural impacts of noise on pygmy blue whales are largely unknown, a precautionary approach has been taken regarding assigning a 'minor' consequence rating.

Blue whales using the foraging area will be either foraging or feeding (Gill, 2020), so given the distance to the behaviour noise criteria is 17.03 km, up to 2.7% of the pygmy blue whale high density foraging BIA (35,627 km^2) may be affected. Given this is a very small intersection, blue whales are still expected to continue foraging within the BIA and in areas that are more prone to upwelling events than the activity area.

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 BIA) 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 have conservation advice (TSSC, 2015c; TSSC, 2015d) has a consequence rating for anthropogenic noise and acoustic disturbance as 'minor', with the extent over which the threat may operate as 'moderate'-'large'. There is no conservation advice for the pygmy right whale and the SPRAT database (DAWE, 2020b) does not identify anthropogenic noise and acoustic disturbance as a threat.

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, 2020b). 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, 2020b). 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 which is approximately 78 km from the ensonified area (95 km from the activity area). 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 Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise as a threat that is classed as a 'minor' consequence, which is defined as individuals are affected but no affect at a population level. The conservation plan details that given the behavioural impacts of noise on southern right whales are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

The closest distance to a southern right whale BIA where biologically important behaviour, such as calving, foraging, resting or migration occurs is 25.6 km from the ensonified area (Figure 7.3). As this is outside of the ensonified area, impacts to these areas 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 (DSEWPaC, 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 southern right whales 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 ensonified area for marine mammal behavioural response is 53 km from the area of potential occupancy for the Port Campbell emerging aggregation area, thus impacts to this area are not predicted.

The ensonified area for marine mammal behavioural response is located within the southern right whale core coastal range. As detailed in Section 5.4.5, there is the potential for southern right whales 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 ground to these aggregation and migration areas. The activity timing overlaps with the latter of these periods. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 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 17.03 km equates to an area of 965 km^2 which is approximately 0.44% of the southern right whale current core coastal range (217,825 km^2). The consequence to marine mammals is assessed as 'minor' and is of an acceptable level because:

Blue whales

- The Conservation Management Plan for the Blue Whale (DoE, 2015d) details that shipping and industrial noise are classed as a 'minor' consequence (individuals are affected but there is no affect at a population level).
- Though the activity is not scheduled to commence during the known pygmy blue whale foraging period, the area of potential behavioural impact is small at 2.7% of the pygmy blue whale high density foraging BIA.
- The pygmy blue whale high density foraging BIA is not restricted and the furthest distance to impact is 17.03 km which is 28.1 km to the nearshore boundary of the BIA and 31.6 km to the offshore boundary of the high-density foraging BIA (Figure 7.4), allowing sufficient space to ensure pygmy blue whales that may avoid the ensonified area where noise levels are potentially above the behavioural response criteria are not displaced from the BIA.
- The behaviour threshold is approximately 78 km from the Bonney Coast Upwelling KEF, which is a known feeding aggregation area (Gill *et al.*, 2011; McCauley *et al.*, 2018). The behaviour threshold is within an area where the occurrence of an upwelling event between 2002 and 2016 was assessed as very unlikely with an upwelling frequency for of <10% (Huang and Wang, 2019). Thus, pygmy blue and other whale foraging is likely to be opportunist within the ensonified area. 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.

Southern right whales

- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) details that shipping and industrial noise are classed as a 'minor' consequence.
- Though the activity will be undertaken during the period when southern right whales may be travelling through the ensonified area to coastal aggregation and migration areas, the area of potential impact is small at 0.44% of its core coastal range.
- The closest distance to a southern right whale BIA where biologically important behaviour, such as calving, foraging, resting or migration (as defined by DoE, 2015d) occur is 25.6 km from the behavioural threshold (Figure 7.3). As this is outside of the ensonified area above the marine mammal behavioural response threshold, impacts to these BIAs are not predicted.

- The behavioural threshold is 53 km from the area of potential occupancy Port Campbell southern right whale emerging aggregation area. Thus, impacts in this area are not predicted.
- Southern right whales 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. Southern right whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (DSEWPaC, 2012a). Along the Australian coast, individual southern right whales use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (DSEWPaC, 2012a). As such, avoidance of the ensonified area is unlikely to prevent or hinder them from undertaking their seasonal migrations.
- Low numbers of southern right whales are predicted within the ensonified area based on aerial surveys in the Otway region (2002 – 2013) that recorded 12 groups of southern right whales 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.

Other low-frequency cetaceans

- The sei and fin whale's conservation advice (TSSC, 2015c; TSSC, 2015d) has a consequence rating for anthropogenic noise and acoustic disturbance as 'minor', with the extent over which the threat may operate as 'moderate' to 'large'.
- The pygmy right whale SPRAT database entry (DAWE, 2020), in lieu of formal 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 ensonified area for marine mammal behavioural response based on the following:
  - The behaviour threshold is 78 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). No BIAs are identified for these species.
  - 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.
- There are no habitats critical to the survival of marine mammals (other than pygmy blue whales) within the ensonified area for behavioural responses.

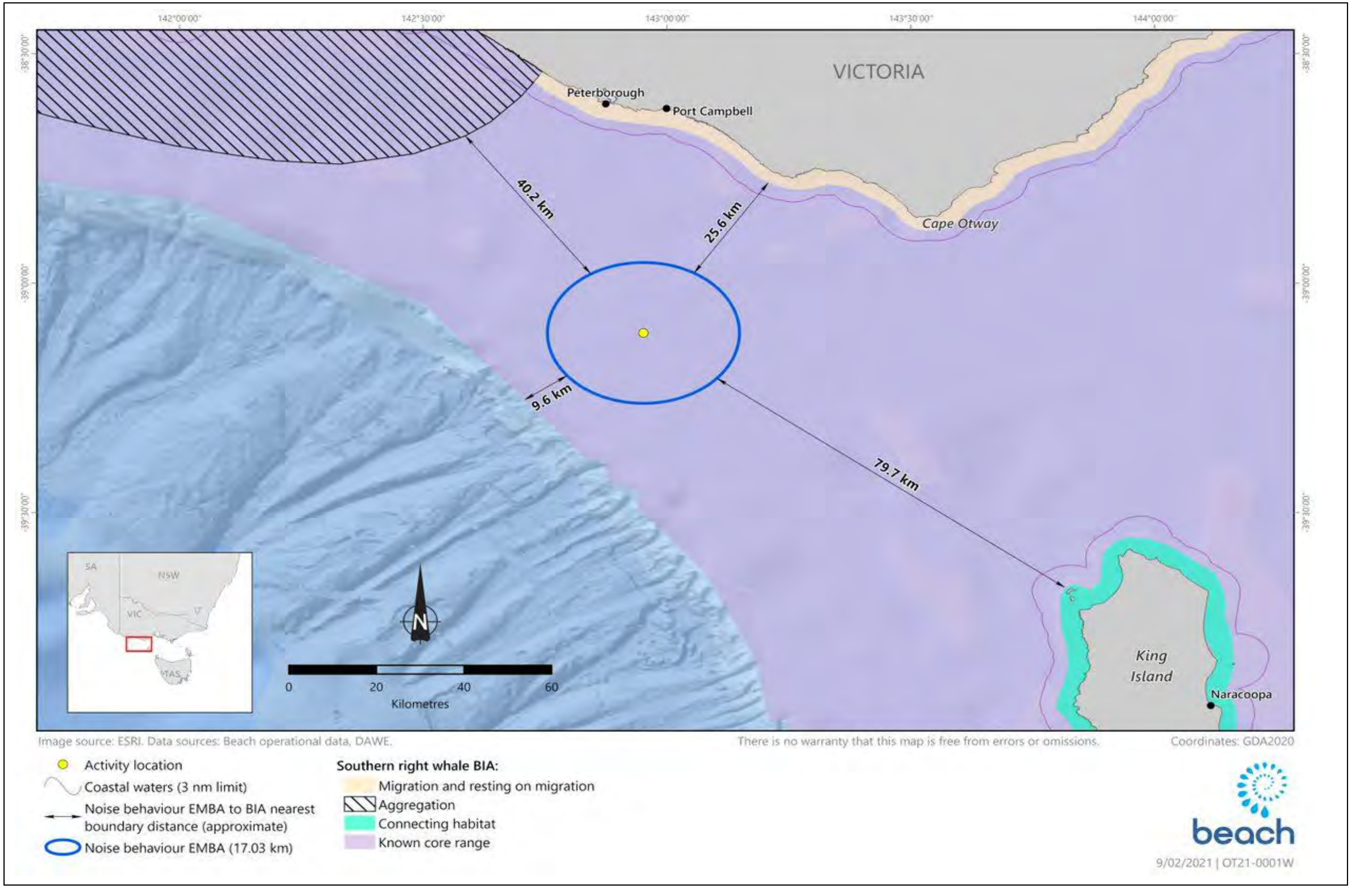


Figure 7.3. Distances from behavioural threshold to southern right whale BIAs

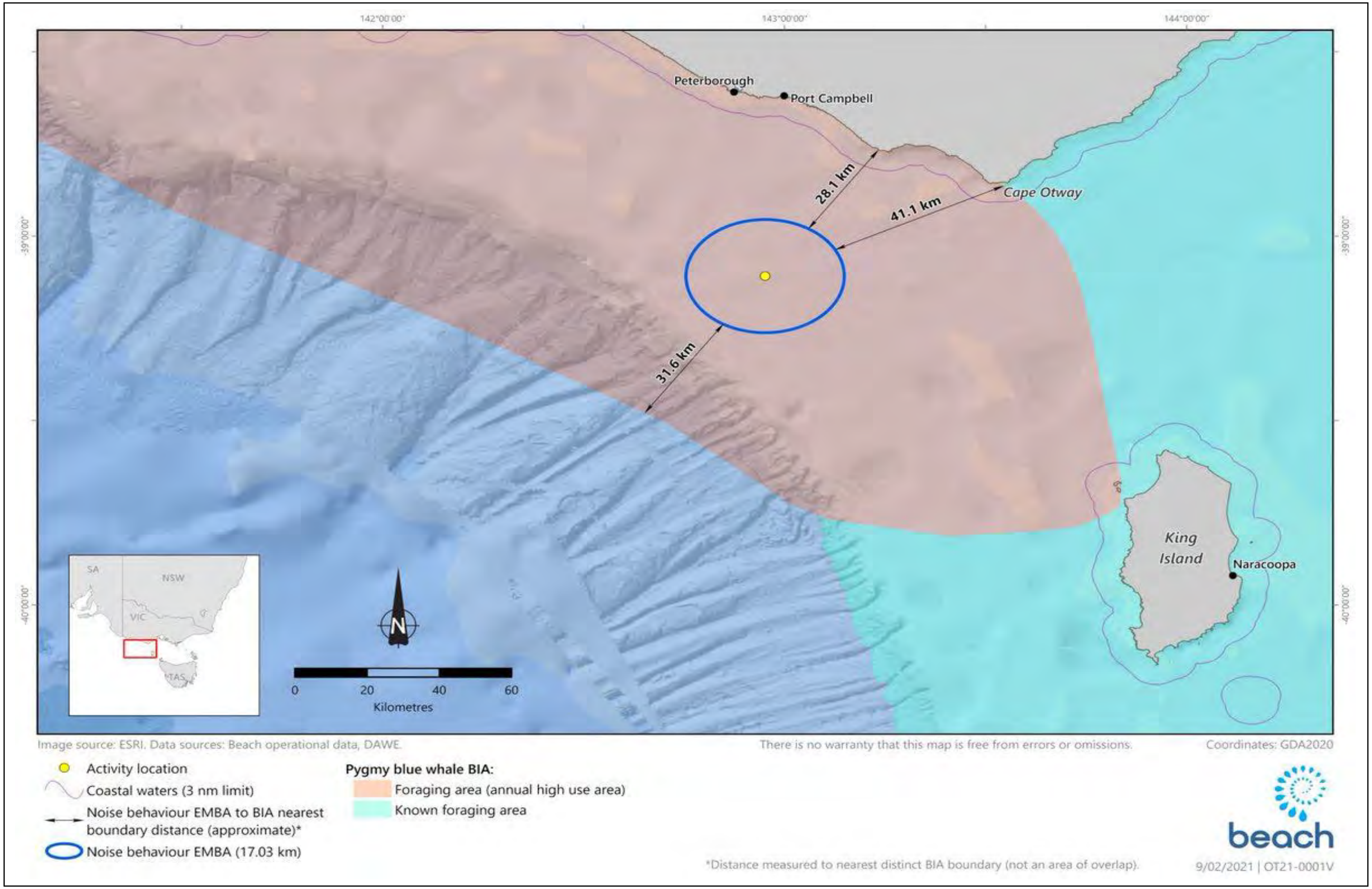


Figure 7.4. Distances from behavioural threshold to pygmy blue whale foraging BIAs

<u>**Cumulative impacts**</u>

While the subsea installation and commissioning activities are taking place, a MODU and support vessels will be present nearby undertaking the Otway Development Drilling and Well Abandonment campaign (described in a separate EP). Though the exact location of the MODU and its support vessels at the time of this activity cannot be confirmed at this stage, the location of the closest potential drill site is 13 km southwest from the activity area (Thylacine North wells). For conservativeness, this is assumed to be the closest potential location of the MODU at the time of the activity.

For the Otway Development Drilling and Well Abandonment campaign, the highest levels of sound are predicted to extend 13.7 km from the Thylacine drill sites (behavioural effects threshold). This means there will be overlap between the ensonified area (for behavioural effects for marine mammals) generated by the CSV and that generated at the drilling location, though no overlap when considering the ensonified area for TTS or PTS. The consequence to marine mammals as a result of cumulative sound is assessed as 'minor' and is of an acceptable level because:

Blue whales

- The Conservation Management Plan for the Blue Whale (DoE, 2015d) states that shipping and industrial noise are classed as a 'minor' consequence (individuals are affected but there is no affect at a population level).
- The activity is scheduled to commence outside of the pygmy blue whale foraging period (January-April).
- The duration of the activity is short-term (up to 30 days) and does not constitute a permanent alteration to the pygmy blue whale foraging BIA.

Southern right whales

- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) states that shipping and industrial noise are classed as a 'minor' consequence.
- The closest distance to a southern right whale BIA where biologically important behaviour, such as calving, foraging, resting or migration (as defined by DoE, 2015d) occur is 25.6 km northeast from the edge of the ensonified area for behavioural effects. As such, impacts to these BIAs are not predicted.
- The duration of the activity is short-term (up to 30 days) and does not constitute a permanent alteration to the southern right whale core coastal range.
- Though the activity will be undertaken during the period when southern right whales may be travelling through the ensonified area (for behavioural effects) to coastal aggregation and migration areas, the area of potential impact is very small (<1%) compared to the total size of its core coastal range.
- Southern right whales may avoid the ensonified area (for behavioural effects) but there is no impediment to them continuing to the coastal aggregation and migration areas. Southern right whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (DSEWPaC, 2012a).
- The emerging southern right whale aggregation area at Port Campbell is located 53 km north of the northern point of the ensonified area for behavioural effects. Thus, impacts in this area are not predicted.
- Low numbers of southern right whales are predicted within the ensonified area based on aerial surveys in the Otway region (2002 – 2013) that recorded 12 groups of southern right whales 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.

Other low-frequency cetaceans

- The sei and fin whale's conservation advice (TSSC, 2015c; TSSC, 2015d) has a consequence rating for anthropogenic noise and acoustic disturbance as 'minor', with the extent over which the threat may operate as 'moderate' to 'large'.
- The pygmy right whale SPRAT database entry (DAWE, 2020), in lieu of formal 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 ensonified area for marine mammal behavioural response based on the following:
    - The behaviour threshold is 78 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). No BIAs are identified for these species.
    - 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.
- There are no habitats critical to the survival of marine mammals (other than pygmy blue whales) within the ensonified area for behavioural responses – though pygmy blue whales are not expected in this area during the activity window.

7.2.5 Impact Assessment

Table 7.9 presents the impact assessment for the generation of underwater sound.

Table 7.9. Impact assessment for underwater sound

Summary	
Summary of impacts	Physiological or pathological impacts to local populations of marine fauna.
Extent of impacts	An EMBA for each of the identified receptors is provided in Table 7.3.
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	Minor
MFC	Minor

HFC		Minor
Pinnipeds		Minor
Turtles		Minor
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.
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.

Control considered	Hierarchy of control type	Analysis
Anchoring of the vessel	Substitution	Vessel noise could be minimised by the CSV anchoring while on location. This is not feasible as the vessel must be able to react to an errant vessel, man overboard or other safety issues. Anchoring may also damage existing infrastructure. In addition, minor adjustments to the vessel position are required throughout the installation of subsea infrastructure. Thus, anchoring of the construction vessel is not a feasible option.
Shut down zones for the vessel	Engineering	Shutting down the vessel DP system could lead to the vessel drifting and colliding with another vessel, potentially resulting in a safety risk to personnel or an MDO spill. It may lead to damage to subsea infrastructure if it is being handled by a crane at the time or, as a worst case, result in a loss of well control if particular subsea infrastructure is damaged. It could also result in a vessel strike to the whales that shutting down the propulsion system is meant to protect.
Use of trained and experienced Marine Mammal Observers (MMOs)	Administrative	MMOs are not a requirement for this activity under EPBC Act Policy Statement 2.1 as the policy covers only seismic surveying, which this activity will not be undertaking. If this policy were implemented and cetaceans were spotted, there is little that could be practically done in terms of reducing sound output from the CSV because shutting down the DP system would not be an option, as it needs to maintain station, especially if equipment is being deployed by crane or ROV, so that equipment is not damaged.

Monitoring upwelling events pre-mobilisation – sea surface temperature and chlorophyll-a	Administrative	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	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 drill. • 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	Drones have been considered as a method of increasing the observation distance of MMOs and monitoring the PTS, TTS and behavioural 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 MMOs 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	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 MMOs 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.
Use of passive acoustic monitoring (PAM) for the detection of cetaceans.	Engineering	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 experienced MMOs 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.
Dedicated monitoring vessel	Administrative	An additional dedicated vessel is not considered ALARP as monitoring activities can effectively be carried out by MMOs situated on the construction vessel. Additional vessels not required for the activity are likely to increase the risk of vessel strike, 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	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.

Demonstration of Acceptability		
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 7.2.4.	
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

<table>
<tr><td></td><td></td><td>planning phase of this activity and can be met during the implementation phase of this activity.</td></tr>
<tr><td>External context (stakeholder engagement)
(see Chapter 4)</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.
Relevance to marine fauna There has been no concern expressed by stakeholders about impacts to marine fauna from underwater sound associated with this activity.</td></tr>
<tr><td>Legislative context
(see Sections 2.2, 2.3 & 2.4 for descriptions of relevant legislation)</td><td colspan="2">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).
o 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).
o 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.</td></tr>
<tr><td rowspan="6">Industry practice</td><td colspan="2">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.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry
(IOGP-IPIECA, 2020)</td><td>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 an MMO.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines specifically regarding underwater noise for offshore activities.</td></tr>
<tr><td>Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities
(Prideaux, 2017)</td><td>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).</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development
(World Bank Group, 2015)</td><td>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.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>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.</td></tr>
<tr><td rowspan="2">Environmental context</td><td colspan="2">MNES</td></tr>
<tr><td>AMPs
(Section 5.5.1)</td><td>The nearest AMP (Apollo) is located 47 km east of the activity area. This is outside the furthest distance to behavioural impacts (17 km). As such, impacts to the conservation values of the AMP are not expected.</td></tr>
</table>

		Appendix 1 provides an assessment of the potential impacts of the activity on the management aims of the South-East Commonwealth Marine Reserves Network Management Plan 2013-23, which encapsulates the Apollo AMP.
	Ramsar wetlands (Section 5.5.4)	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 (Section 5.5.6)	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 (Section 5.5.7)	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 (Section 5.5.8)	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 (Section 5.4)	**Cetaceans:** The activity will not have a 'significant' impact on critically endangered or vulnerable cetacean species (see Section 5.4.5) 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. **Fish:** The activity will not have a 'significant' impact on threatened fish species (see Section 5.4.7), 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, which predicts furthest distance to PTS and TTS as <0.03 km and 0.12 km, respectively.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	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, which is located 42 km northeast of the activity area.
	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). Appendix 2 provides an assessment of the potential impacts of the activity on the management aims of threatened species 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 distances of 17 km 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.
Environmental Monitoring		
• None required		
Record Keeping		
• Cetacean sightings		

7.3 IMPACT 3 – Discharge of Chemicals

7.3.1 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 Macdermid Oceanic 443 hydraulic fluid may be released.

7.3.2 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.

7.3.3 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.

7.3.4 Evaluation of Environmental Impacts

MEG has a low toxicity, is readily biodegradable and is rated as posing little or no risk to the environment (PLONOR) and 'E' (non-CHARM) in the OCNS rankings. The fluid proposed for use in the HFL function test (MacDermid Oceanic 443) is a water-based fluid that is ranked "D" in the OCNS ranking. 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.

7.3.5 Impact Assessment

Table 7.10 presents the impact assessment for discharge of chemicals.

Table 7.10. 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	Stakeholders have not raised concerns about chemical discharges 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): o 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 (Section 5.5.1)	Localised chemical discharge will not have any impact on AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Localised chemical discharge does not have any impacts on Ramsar wetlands.
	TECs (Section 5.5.6)	Localised chemical discharge will not have any impacts on TECs.
	NIWs (Section 5.5.8)	Localised chemical discharge will not have any impacts on NIWs.
	Nationally threatened and migratory species (Section 5.4)	Localised chemical discharge will not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Localised chemical discharge will not have any impacts on state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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		
• ROV monitoring during filling of grout bags.		

Record Keeping
• Chemical inventory. • MoC documents.

7.4 IMPACT 4 – Routine Emissions - Light

7.4.1 Hazards

Light emissions will always occur from the CSV. The following activities will result in artificial lighting:

- Vessel navigation lighting will be maintained while on location for maritime safety purposes and deck lighting for the safety of personnel working on deck.

7.4.2 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).

7.4.3 EMBA

The EMBA for light emissions associated with vessel activities is likely to be less than a 100 m radius of the vessel.

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

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

7.4.4 Evaluation of Environmental Impacts

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

There are no turtle nesting beaches in Bass Strait, so impacts of light to turtles are not assessed here.

The distance of the closest point of the activity area from the nearest shoreline (45 km) and nearest town (Princetown, 49 km) means vessel lighting is not visible from land and the impacts of light from the CSV to coastal communities will not occur.

Seabirds

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.

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

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.

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.

7.4.5 Impact Assessment

Table 7.11 presents the impact assessment for light emissions.

Table 7.11.Impact assessment for light emissions

Summary	
Summary of impacts	Light glow 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	Localised (small radius of light glow around the vessel).
Duration of impacts	Temporary - duration of activity.
Level of certainty of impacts	HIGH - the impacts of light glow 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
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.	Lighting is directed to working areas (rather than overboard) to minimise light spill to the ocean.	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 directed overboard can be manually over-ridden (with a local switch where possible) such that it is only switched on as required (e.g., man overboard).	
	Blinds will be lowered on all portholes and windows at night.	Completed daily environmental checklists and photos verify that blinds are drawn each night.

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 stakeholders about impacts from lighting with this activity.	
Legislative context	The EPS outlined in this EP align with the requirements of: • *Navigation Act* 2012 (Cth): o Part 3 (Prevention of Collisions). o AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). o AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). o 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	There are no guidelines specifically regarding lighting for offshore activities.

	Exploration and Production (European Commission, 2019)	
	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)	An assessment of the activity against these guidelines is included in Appendix 1. 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 (Section 5.5.1)	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. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Localised light glow will not have any impacts on Ramsar wetlands.
	TECs (Section 5.5.6)	Localised light glow will not have any impacts on TECs.
	NIWs (Section 5.5.8)	Localised light glow will not have any impacts on nationally important wetlands.
	Nationally threatened and migratory species (Section 5.4)	Localised light glow does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Localised light glow does not have any impacts on state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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 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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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		
• Fauna interactions with lighting.		
Record Keeping		
• Vessel class certification		

7.5 IMPACT 5 – Routine Emissions - Atmospheric

7.5.1 Hazards

The following activities generate atmospheric emissions:

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

7.5.2 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).

7.5.3 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.

7.5.4 Evaluation of Environmental Impacts

<u>Localised and temporary decrease in air quality from diesel combustion</u>

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.

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.

7.5.5 Impact Assessment

Table 7.12 presents the impact assessment for atmospheric emissions.

Table 7.12. 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	ODS record book is available and current.

	managed to minimise Ozone Depleting Substances (ODS).	
Solid combustible waste will only be burned within an incinerator, and only if logistics don't allow for the timely removal of waste from the vessel.	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.
	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 stakeholders, and actively involved stakeholders known to have concerns with the activity. There has been no concern expressed by stakeholders 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): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order Part 79 (Marine pollution prevention – air pollution). • *Protection of the Sea (Prevention of Pollution by Ships) Act 1983* (Cth): o Part IIID (Prevention of Air Pollution). o 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; o Use of high efficiency equipment to minimise power demand.

		o Selection of low sulphur diesel. o Regular plant maintenance. o Regular maintenance and emission control devices on vehicles and machinery.
	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 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 (Section 5.5.1)	Atmospheric emissions will not directly affect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Atmospheric emissions will not directly affect any Ramsar wetlands.
	TECs (Section 5.5.6)	Atmospheric emissions will not directly affect any TECs.
	NIWs (Section 5.5.8)	Atmospheric emissions will not directly affect any nationally important wetlands.
	Nationally threatened and migratory species (Section 5.4)	Atmospheric emissions will not directly affect threated or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Atmospheric emissions will not directly affect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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, Southern Right and Humpback 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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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
• 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.

7.6 IMPACT 6 – Routine Discharges - Putrescible Waste

7.6.1 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).

7.6.2 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).

7.6.3 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.

7.6.4 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.

7.6.5 Impact Assessment

Table 7.13 presents the impact assessment for putrescible waste discharges.

Table 7.**13 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 stakeholders 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	The EPS listed in this table meet these guidelines for offshore activities with regard to:

	Exploration and Production (European Commission, 2019)	• 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 (Section 5.5.1)	Putrescible waste discharges will not intersect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Putrescible waste discharges will not intersect any Ramsar wetlands.
	TECs (Section 5.5.6)	Putrescible waste discharges will not intersect any TECs.
	NIWs (Section 5.5.8)	Putrescible waste discharges will not intersect any nationally important wetlands.
	Nationally threatened and migratory species (Section 5.4)	Putrescible waste discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	This hazard will not intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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

- Volume/weight of non-macerated waste sent ashore.

Record Keeping

- GMP.
- PMS records.
- Garbage Record Book.
- Training matrix.
- Induction records.

7.7 IMPACT 7 – Routine Discharges - Sewage and Grey Water

7.7.1 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.

7.7.2 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.

7.7.3 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.

7.7.4 Evaluation of Environmental Impacts

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.

Biological receptors

Plankton forms the basis of all marine ecosystems, and plankton communities have a naturally patchy distribution in both space and time (ITOPF, 2011). 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, 2011).

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.

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.

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.

7.7.5 Impact Assessment

Table 7.14 presents the impact assessment for the discharge of treated sewage and grey water.

Table 7.**14. 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 vessel is greater than 12 nm from shore.	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 with Regulation 11 of MARPOL Annex IV (enacted by AMSA Marine Orders Part 96, Sewage).	Activity-specific discharges and emissions register verifies that untreated sewage is 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	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 stakeholders 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): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order 95 (Marine Pollution Prevention - sewage). • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): o 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 (Section 5.5.1)	Sewage and grey water discharges will not intersect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Sewage and grey water discharges will not intersect any Ramsar wetlands.
	TECs (Section 5.5.6)	Sewage and grey water discharges will not intersect any TECs.
	NIWs (Section 5.5.8)	Sewage and grey water discharges will not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.4)	Sewage and grey water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	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. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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		

• None required.
Record Keeping
• ISPP certificate. • STP PMS records. • Activity-specific discharges and emissions register.

7.8 IMPACT 8 – Routine Discharges - Cooling and Brine Water

7.8.1 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.

7.8.2 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.

7.8.3 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.

7.8.4 Evaluation of Environmental Impact

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.

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.

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.

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.

7.8.5 Impact Assessment

Table 7.15 presents the impact assessment for the discharge of cooling and brine water.

Table 7.15. 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 low-toxicity chemicals are used in the cooling and brine water systems.	Only OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated chemicals (i.e., low toxicity) are used in the cooling and brine water systems.	Vessel chemical inventories records verify that biocides and scale inhibitors are of low toxicity.
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 stakeholders about impacts from cooling and brine water discharges for this activity.	
Legislative context	There are no legislative controls regarding cooling and brine water discharges.	
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 (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.
	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 cooling and brine water discharges.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	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.
	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 (Section 5.5.1)	Cooling and brine water discharges will not intersect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Cooling and brine water discharges will not intersect any Ramsar wetlands.
	TECs (Section 5.5.6)	Cooling and brine water discharges will not intersect any TECs.
	NIWs (Section 5.5.8)	Cooling and brine water discharges will not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.4)	Cooling and brine water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Cooling and brine water discharges will not intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of state marine parks.

	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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		
• None required		
Record Keeping		
• PMS records. • Chemical inventories.		

7.9 IMPACT 9 – Routine Discharges - Bilge Water and Deck Drainage

7.9.1 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.

7.9.2 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.

7.9.3 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.

7.9.4 Evaluation of Environmental Impact

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).

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).

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.

7.9.5 Impact Assessment

Table 7.16 presents the impact assessment for the discharge of bilge water and deck drainage.

Table 7.16. 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 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.

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.	

<table>
<tr><td></td><td colspan="2">There has been no concern expressed by stakeholders about impacts from bilge water and deck drainage discharges for this activity.</td></tr>
<tr><td>Legislative context</td><td colspan="2">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).</td></tr>
<tr><td rowspan="4">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 (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.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>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.</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:
• 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</td></tr>
</table>

		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 (Section 5.5.1)	Bilge water and deck drainage discharges will not intersect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	Bilge water and deck drainage discharges will not intersect any Ramsar wetlands.
	TECs (Section 5.5.6)	Bilge water and deck drainage discharges will not intersect any TECs.
	NIWs (Section 5.5.8)	Bilge water and deck drainage discharges will not intersect any nationally important wetlands.
	Nationally threatened and migratory species (Section 5.4)	Bilge water and deck drainage discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	Bilge water and deck drainage discharges will not intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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

- None required

Record Keeping

- PMS records.
- IOPP certificate.
- Oil Record Book.
- Crew training records.
- Inspection and checklist records.
- P&IDs.
- SDS (for deck cleaning agents).
- Incident reports.
- SMPEP.

7.10 RISK 1 – Displacement of or Interference with Third-party Vessels

7.10.1 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.

7.10.2 Known and potential environmental risks

The known and potential impacts of the displacement of or interference with third-party vessels are:

- Collision potential with third-party vessels (and damage in the case of collision);
- Diversion of third-party vessels from their navigation paths; and
- Damage to or loss of fishing equipment and/or loss of commercial fish catches.

7.10.3 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:

- Pelagic fauna (plankton, fish, cetaceans);
- Benthic invertebrates;
- Benthic habitat (sandy seabed);
- Commercial fishers;
- Commercial and recreational fishing vessels; and
- Merchant vessels.

7.10.4 Evaluation of environmental risks

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 and will be located within an existing PSZ, 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 Section 5.7.6) and the existing PSZ.

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 7.14).

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 breach the PSZ, 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.

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.

7.10.5 Risk Assessment

Table 7.17 presents the risk assessment for the displacement of or interference with third-party vessels.

Table 7.**17. 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-party vessels or fishing equipment.	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.	
	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 stakeholders 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). o 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). o Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions). o AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). o AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). o 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 (Section 5.5.1)	This hazard does not intersect nearby AMPs. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	This hazard will not intersect any Ramsar wetlands.
	TECs (Section 5.5.6)	This hazard will not intersect any TECs.
	NIWs (Section 5.5.8)	This hazard will not intersect any NIWs.

	Nationally threatened and migratory species (Section 5.4)	This hazard does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	This hazard will not intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See Appendix 2 for additional detail regarding the impacts of routine activities on the management aims of threatened species 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		
• Continuous bridge monitoring		
Record Keeping		
• Stakeholder consultation communication records. • Notice to Mariners. • AusCoast warnings.	• Bridge communication logs. • Crew qualifications. • Incident reports.	

7.11 RISK 2 - Accidental Discharge of Hazardous and Non-hazardous Materials and Waste to the Ocean

7.11.1 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.

7.11.2 Potential environmental risks

The risks 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.

7.11.3 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, 2018a):

- 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.

7.11.4 Evaluation of Environmental Risks

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, 2018a). 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, 2018a). 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.

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.

7.11.5 Risk Assessment

Table 7.18 presents the risk assessment for the accidental disposal of hazardous and non-hazardous materials and waste.

Table 7.18. 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. 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.	Training records verify that vessel crews receive spill response training.
		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 stakeholders 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): o Chapter 4 (Prevention of Pollution). o Marine Orders Part 47. o Marine Orders Part 94 (Marine pollution prevention – packaged harmful substances). o Marine Orders Part 95 (Marine pollution prevention – garbage). • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): o Part III (Prevention of pollution by noxious substances). o Part IIIA (Prevention of pollution by packaged harmful substances). o 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 Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Waste management (items 46). Materials should be segregated offshore and shipped to shore for reuse, 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 (Section 5.5.1)	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 (Section 5.5.4)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach Ramsar wetlands.
	TECs (Section 5.5.6)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any TECs.
	NIWs (Section 5.5.8)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any NIWs.
	Nationally threatened and migratory species (Section 5.4)	The unplanned discharge of solid or hazardous waste is highly unlikely to have any impacts on threatened or migratory species.
	Other matters	

	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of non-routine activities on the management aims of 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 advice for humpback whales (TSSC, 2015b) and the Conservation Management Plan for the Blue Whale (DoE, 2015d) identify marine debris as a threat, but there are no conservation management actions to counter this. The 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. See Appendix 2 for additional detail regarding the impacts of non-routine activities on the management aims of threatened species 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

- Waste tracking.

Record Keeping

- Vessel contractor pre-qualification report/s.
- GMP.
- Garbage Record Book.
- Crew induction and attendance records.
- Inspection records/checklists.
- Shore-based waste contract.
- Incident reports.

7.12 RISK 3 – Vessel Collision or Entanglement with Megafauna

7.12.1 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).

7.12.2 Potential environmental risks

The risks of vessel strike with megafauna are:

- Injury; and
- Death.

7.12.3 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); and
- Pinnipeds (fur-seals).

7.12.4 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 5.5.5).
- 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 5.5.5).
- 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 (2015d) 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 DoE (2015d) 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 southern right whales, humpback whales and pygmy 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.

7.12.5 Risk Assessment

Table 7.19 presents the risk assessment for vessel collision with megafauna.

Table 7.19. 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.		Daily operations reports note when cetaceans and pinnipeds were sighted and what actions were taken to avoid collision or entanglement.

	• If there is a need to stop, reduce speed gradually.	
	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	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 stakeholders 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): o Section 199 (failing to notify taking of listed species or listed ecological community). • EPBC Regulations 2000 (Cth): o Part 8 (Interacting with cetaceans and whale watching). o 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 (Section 5.5.1)	The risk of collisions with megafauna does not have any effect on nearby AMPs. See Appendix 1 for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	The risk of collisions with megafauna will not have any effect on Ramsar wetlands.
	TECs (Section 5.5.6)	The risk of collisions with megafauna will not have any effect on TECs.
	NIWs (Section 5.5.8)	The risk of collisions with megafauna will not have any effect on NIWs.
	Nationally threatened and migratory species (Section 5.4)	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 (Sections 5.4.9, 5.4.10 & 5.4.11)	The risk of collisions with megafauna will not have any effect on state marine parks.
	Species Conservation Advice/	Vessel collisions (and/or entanglements) are listed as a threat to cetaceans in the:

	Recovery Plans/ Threat Abatement Plans	• 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); and • Conservation advice for the humpback whale (TSSC, 2015b). 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. See Appendix 2 for additional detail regarding the impacts of non-routine activities on the management aims of threatened species 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.		

7.13 RISK 4 - Introduction and Establishment of Invasive Marine Species

7.13.1 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.

7.13.2 Potential environment risks

The risks 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.

7.13.3 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.

7.13.4 Evaluation of Environmental Risks

Successful IMS invasion requires the following three steps:

1. Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
2. Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., activity area).
3. 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.

7.13.5 Risk Assessment

Table 7.20 presents the risk assessment for the introduction of IMS.

Table 7.20. 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 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.	Biofouling assessment report prior to mobilising to site confirms acceptability to enter the activity area
	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;	Vessel contractor Biofouling Management Plan and Biofouling Record Book are available and current.

	• 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.	
	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).
	  o If intending to discharge internationally-sourced ballast water, submit BWR through MARS at least 12 hours prior to arrival.
	  o 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).
		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.
		
		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.*	As above, except for the BWR.

	• *Ballast water was taken up on the high seas only.* • *The vessel receives a risk-based exemption from ballast water management.*	
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 (contact details in Section 8.9).	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 stakeholders 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): o Chapter 4 (Managing biosecurity risk). o Chapter 5, Part 3 (Management of discharge of ballast water). • *Protection of the Sea (Harmful Anti-fouling Systems) Act* 2006 (Cth): o Part 2 (Application or use of harmful anti-fouling systems). o Part 3 (Anti-fouling certificates and anti-fouling declarations). o 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	There are no guidelines for offshore activities with regard to minimising the risk of introducing IMS.

	Exploration and Production (European Commission, 2019)	
	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 (Section 5.5.1)	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 (Section 5.5.4)	The risk of introducing IMS is highly unlikely to affect Ramsar wetlands.
	TECs (Section 5.5.6)	The risk of introducing IMS is highly unlikely to affect TECs.
	NIWs (Section 5.5.8)	The risk of introducing IMS is highly unlikely to affect NIWs.

	Nationally threatened and migratory species (Section 5.4)	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 (Sections 5.4.9, 5.4.10 & 5.4.11)	This hazard does not intersect any state marine parks. See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of 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). See Appendix 2 for additional detail regarding the impacts of non-routine activities on the management aims of threatened species 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).	
	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.
- Biofouling risk assessment.
- Ballast water risk assessments.
- BWMP.
- BWR.
- BWMC.
- BWRS.
- IAFS Certificates.
- DAWR-signed ePARs.

7.14 RISK 5 – MDO Release

7.14.1 Hazard

A release of MDO may occur from the CSV as a result of:

- A vessel-to-vessel collision;
- Mechanical failure;
- Navigational error; and
- Foundering due to weather.

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.

MDO properties

The following points summarise the nature and behaviour of MDO, based on NOAA (2012) and APASA (2012):

- MDO is dominated by n-alkane hydrocarbons that give diesel its unique compression ignition characteristics and usually consist of carbon chain C_{11}-C_{28} but may vary depending upon specifications (e.g., winter vs. summer grades).
- While MDOs are generally considered to be non-persistent oils, many can contain a small percentage (approximately 3-7%) by volume of hydrocarbons that are classified as 'persistent' under IOPC Fund definition (i.e., greater than 5% boiling above 370°C) (see Table 7.21).
- Diesel fuels are light, refined petroleum products with a relatively narrow boiling range, meaning that when spilled on water, most of the oil evaporates or naturally disperses quickly (hours to days).
- Diesel fuels are much lighter than water, so it is not possible for diesel oil to sink and accumulate on the seabed as pooled or free oil.
- Dispersion into the sea by the action of wind and waves can result in 25–50% of the loss of hydrocarbons from surface slicks and dissolution (solubility of hydrocarbons) can account for 1-10% loss from the surface. While the majority of the MDO evaporates quickly, it is common for the residues of MDO spills after weathering to contain n-alkanes, iso-alkanes and naphthenic hydrocarbons.
- Minor quantities of PAHs will be present.
- When spilled on water, MDO spreads very quickly to a thin film and generally has a low viscosity that can result in hydrocarbons becoming physically dispersed as fine droplets into the water column when winds exceed 10 knots.
- Droplets of MDO that are naturally or chemically dispersed sub-surface behave quite differently to oil on the sea surface. Diesel droplets will move 100% with the currents under water but on the surface are affected by both wind and currents.
- Natural dispersion of MDOs will reduce the hydrocarbons available to evaporate into the air. Although this reduces the volume of hydrocarbons on the water surface, it increases the level of hydrocarbons able to be inhaled.
- This increased hydrocarbon vapour exposure can affect any air breathing animal including whales, dolphins, seals and turtles.
- The environmental effects of MDO spills are not as visually obvious as those of heavy fuel oils (HFO) or crude oils. Diesel oil is considered to have a higher aquatic toxicity in comparison to many other crude oils due to the:
    - High percentage of toxic, water-soluble components (such as BTEX and PAH);
    - Higher potential to naturally entrain in the water column (compared to HFO);
    - Higher solubility in water; and
    - Higher potential to bioaccumulate in organisms.
- Diesel fuel oils are not very sticky or viscous compared to black oils. When diesel oil strands on a shoreline, it generally penetrates porous sediments quickly, but is also washed off quickly by waves.
- In open water, diesel oil spills are so rapidly diluted that fish kills are rarely observed (this is more likely in confined, shallow waters).

<u>Oil Spill Trajectory Modelling</u>

To understand the risks posed by a MDO spill, Beach commissioned RPS to undertake OSTM in the Otway Basin. The modelling was undertaken for the Artisan-1 drilling campaign (this site is located 25 km northwest of the activity area, closer to the coastline). The scenario modelled was a release of 300 m^3 of MDO in the event of a loss of containment from a vessel at the Artisan-1 drill site for a duration of 6 hours during winter and summer conditions (RPS, 2019). Due to the proximity of the Artisan-1 site to the activity area and that the spill volume is also relevant to this activity, this modelling is considered suitable for use in this activity (and is likely to be more conservative because the activity is located further from shorelines).

The scenario was simulated 100 times during 'winter' weather conditions (April – September) and 100 times during 'summer' weather conditions (October – March). The modelling used the MDO properties outlined in Table 7.21.

Table 7.21. Summary of the MDO spill OSTM inputs.

Characteristic	Details
Density (kg/m^3)	829.1 at 15°C
API	37.6
Dynamic viscosity (cP)	4.0 at 20°C
Pour point (°C)	-14
Oil property category	Group II
Oil persistence classification	Light persistent oil

Table 7.22 presents the physical characteristics of the typical MDO, verifying its volatile nature (i.e., it is quick to weather).

Table 7.**22. Physical characteristics of MDO**

	Volatiles	Semi-volatiles	Low Volatiles	Residual Oil
Boiling Point (°C)	< 180	180-265	265-380	> 380
MDO (%)	6.0	34.6	54.4	5.0
Persistence	Non-persistent			Persistent

Table 7.23 outlines the key OSTM inputs for the MDO spill scenario and spill thresholds used in the OSTM.

Table 7.23. Summary of the MDO spill OSTM inputs.

Parameter	Details
Oil Type	MDO
Total spill volume	300 m^3
Release type	Sea surface
Release duration	6 hours
Release rate	50 m^3/hr
Simulation duration	30 days
Number of simulations	200 (100 for each season)

Surface oil concentration thresholds (g/m^2)	0.5 g/m^2 – low exposure 10 g/m^2 – moderate exposure 25 g/m^2 – high exposure
Shoreline load threshold (g/m^2)	10 g/m^2 – low exposure 100 g/m^2 – moderate exposure 1,000 g/m^2 – high exposure
Dissolved aromatic dosages to assess potential exposure (ppb)	6 ppb – low exposure 50 ppb – moderate exposure 400 ppb – high exposure
Entrained oil dosages to assess potential exposure (ppb)	10 ppb – low exposure 100 ppb – moderate exposure 1,000 – high exposure

Exposure Values

Exposure Values

The outputs of the OSTM are used to assess the environmental risk if a credible hydrocarbon spill scenario occurred, by defining which areas of the marine environment could be exposed to hydrocarbon concentrations that exceed exposure values that may result in impact to sensitive receptors. The degree of impact will depend on the sensitivity of the biota contacted, the duration of the exposure and the toxicity of the hydrocarbon mixture making the contact. The toxicity of a hydrocarbon will change over time, due to weathering processes altering the composition of the hydrocarbon.

The modelling considered four key physical or chemical phases of hydrocarbons that pose differing environmental and socioeconomic risks:

- Surface hydrocarbons;
- Entrained hydrocarbons;
- Dissolved hydrocarbons; and
- Shoreline accumulated hydrocarbons.

The modelling used defined hydrocarbon exposure values, as relevant for risk assessment and oil spill planning, for the various hydrocarbon phases. To ensure conservatism in the environmental assessment process, the exposure values applied to the model are selected to adopt the most sensitive receptors that may be exposed, the longest likely exposure times and the more toxic hydrocarbons.

Exposure values applied for surface, entrained, dissolved and shoreline accumulated hydrocarbons used in the modelling study are summarised in Table 7.23. The adopted exposure values are based primarily on the exposure values defined in NOPSEMA Bulletin #1 Oil Spill Modelling (April 2019). In some instances, slightly more conservative thresholds have been adopted. For example, the low surface exposure of <0.5 g/m^2 was adopted for the modelling, while the NOPSEMA bulletin recommends 1 g/m^2.

Spill Location

For this assessment, the location of the Artisan-1 drill site (25 km northwest of the activity area) was adopted due to its proximity.

Spill Volume

AMSA's *Technical Guidelines for preparing Contingency Plans for Marine and Coastal Facilities* (AMSA, 2015, pg 24) indicates that an appropriate spill size for a vessel collision (a non-oil tanker) should be based on the volume of the largest tank. Beach has used this guidance in determining the volume to be modelled for this study. Given that the CSV has yet to be contracted, the exact volume of MDO to be carried cannot be provided. However, of the construction vessels likely to be used for this activity, analysis of total fuel capacity indicates that the single largest tank size would not be more than 300 m^3. As such, a spill size of 300 m^3 is considered to be an accurate figure to use for this OSTM.

Sea Surface Results

A summary of the sea surface OSTM results for the MDO spill scenario is illustrated in Figure 7.5 and Figure 7.6. The sea surface OSTM results indicate that low exposure contact may be made with the Apollo AMP.

During summer conditions, moderate (10 g/m^2) exposure to surface hydrocarbons were predicted to travel a maximum distance of 12 km from the release location. During winter, moderate exposure of surface hydrocarbons extended to a maximum distance of 10 km from the release location.

None of the receptors identified within the modelling report were exposed at or above the moderate or high (>25 g/m^2) thresholds. However, spill modelling indicates potential summer and winter exposure to surface waters up to a maximum of 6 km from the release location of 48% and 41% probability respectively

Weathering results for this MDO spill scenario are illustrated in Figure 7.7. Due to its chemical composition, approximately 40% will evaporate within the first day, with the remaining volatiles evaporating over 3-4 days depending upon the prevailing conditions.

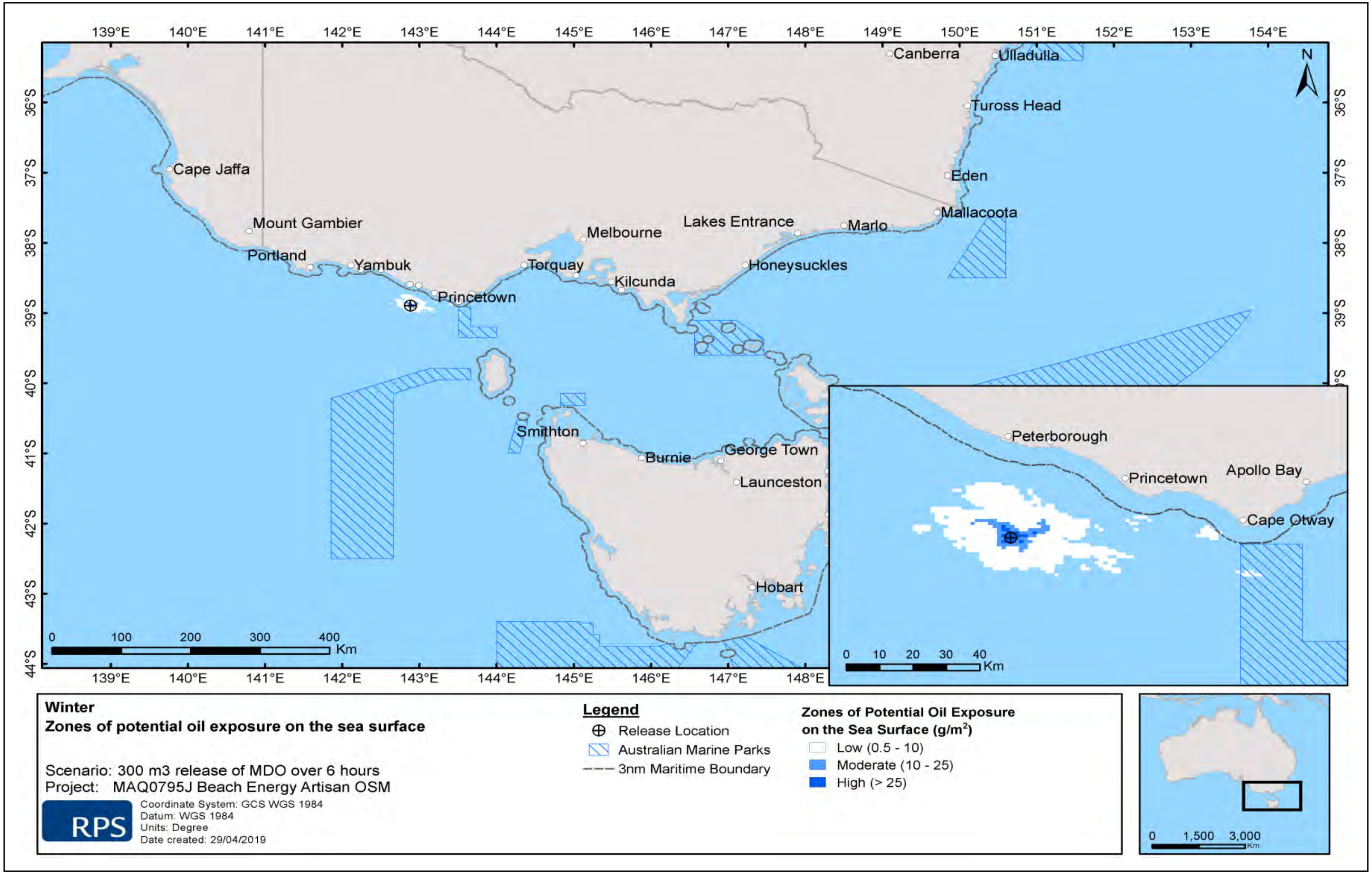


Figure 7.5. Zones of potential MDO exposure on the sea surface in the event of a 300 m^3 surface release over six hours, tracked for 30 days. Results calculated from 100 spill trajectories simulated during winter (April to September) wind and current conditions.

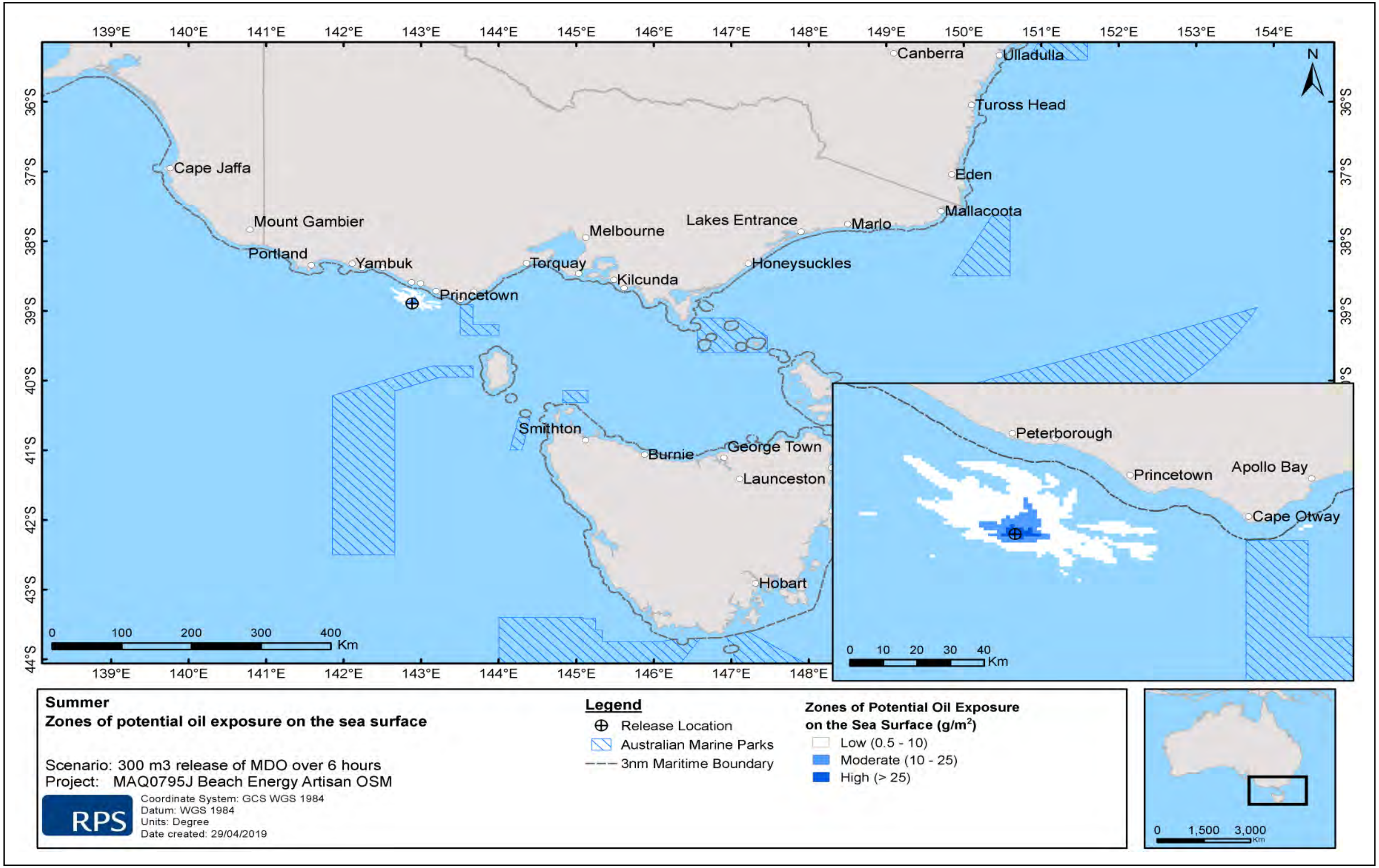


Figure 7.6. Zones of potential MDO exposure on the sea surface in the event of a 300 m3 surface release over six hours, tracked for 30 days. Results calculated from 100 spill trajectories simulated during summer (October to March) wind and current conditions.

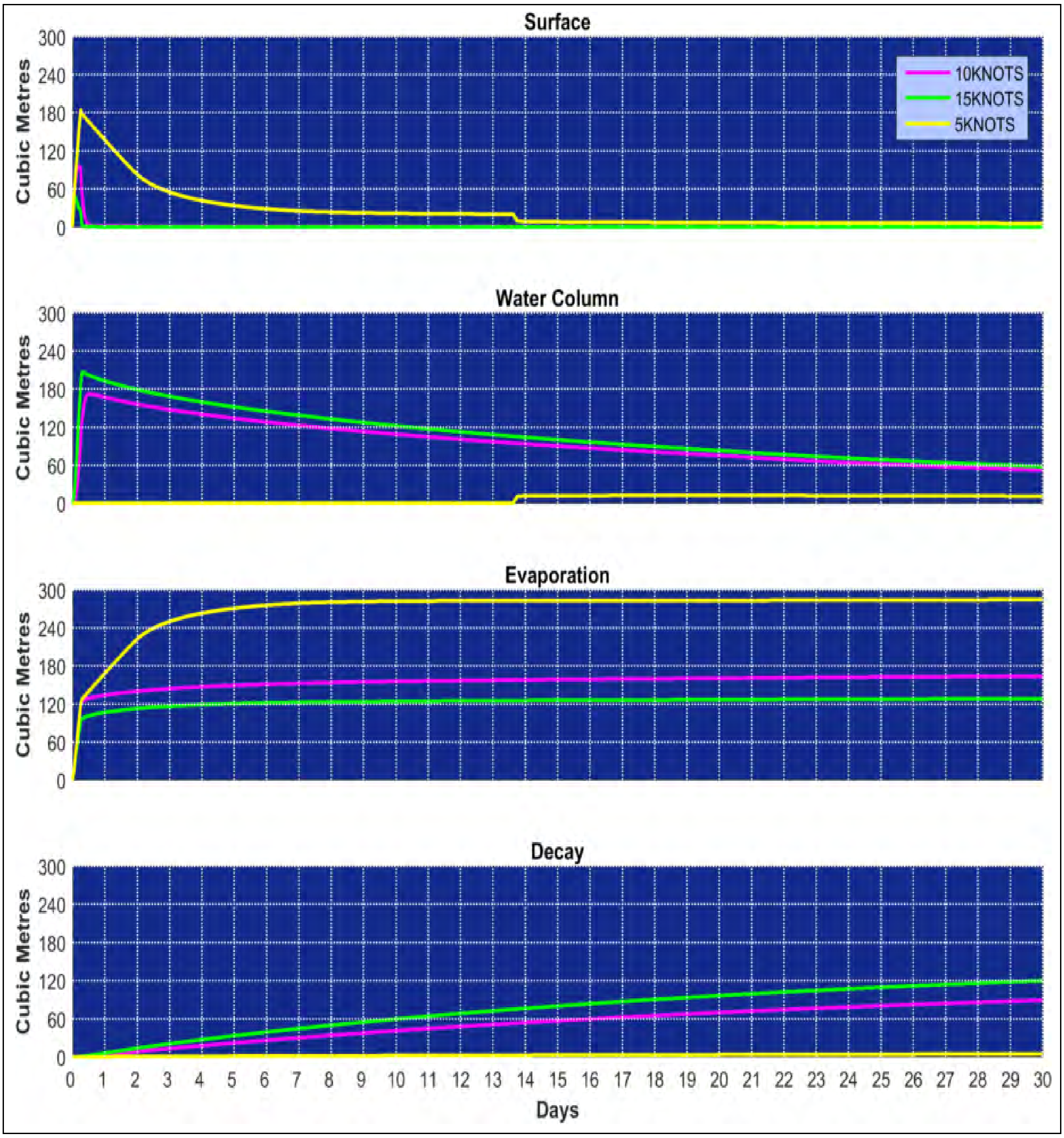


Figure 7.7. Predicted weathering and fate of a 300 m^3 surface release of MDO over six hours (tracked for 30 days) under three static wind conditions (5, 10 and 15 knots).

Shoreline Results

No shoreline contact above the minimum threshold was predicted for either of the seasons modelled.

Entrained Hydrocarbon Results

Figure 7.8 to Figure 7.11 illustrates the zones of potential entrained hydrocarbon exposure at 0-10 m and 10-20 m below the sea surface, respectively.

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure (over a 48-hour window) during summer and winter conditions was 2,182 ppb and 792 ppb, respectively. While there is potential (1-2% probability) of low (10 ppb) exposure (over a 48-hour window) in open waters surrounding the release location, none of the identified receptors were exposed at or above the moderate (10-100 ppb) or high (>1,000 ppb) thresholds.

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

Dissolved Hydrocarbons Results

Figure 7.12 to Figure 7.15 illustrate the zones of potential dissolved hydrocarbon exposure at 0-10 m and 10-20 m below the sea surface.

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

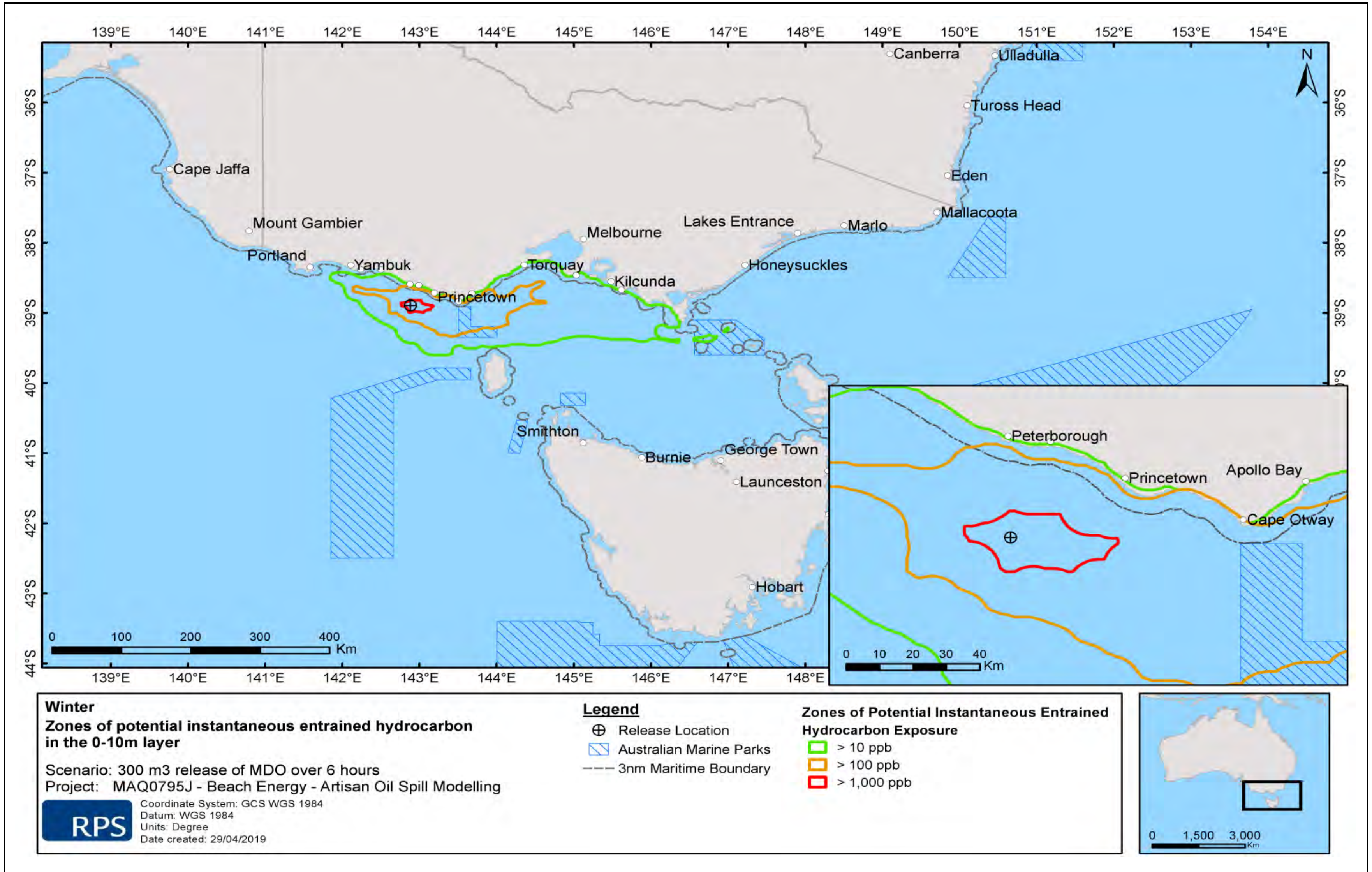


Figure 7.8. Zone of potential 1 hour entrained hydrocarbon exposure at 0–10 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (April to September) wind and current conditions.

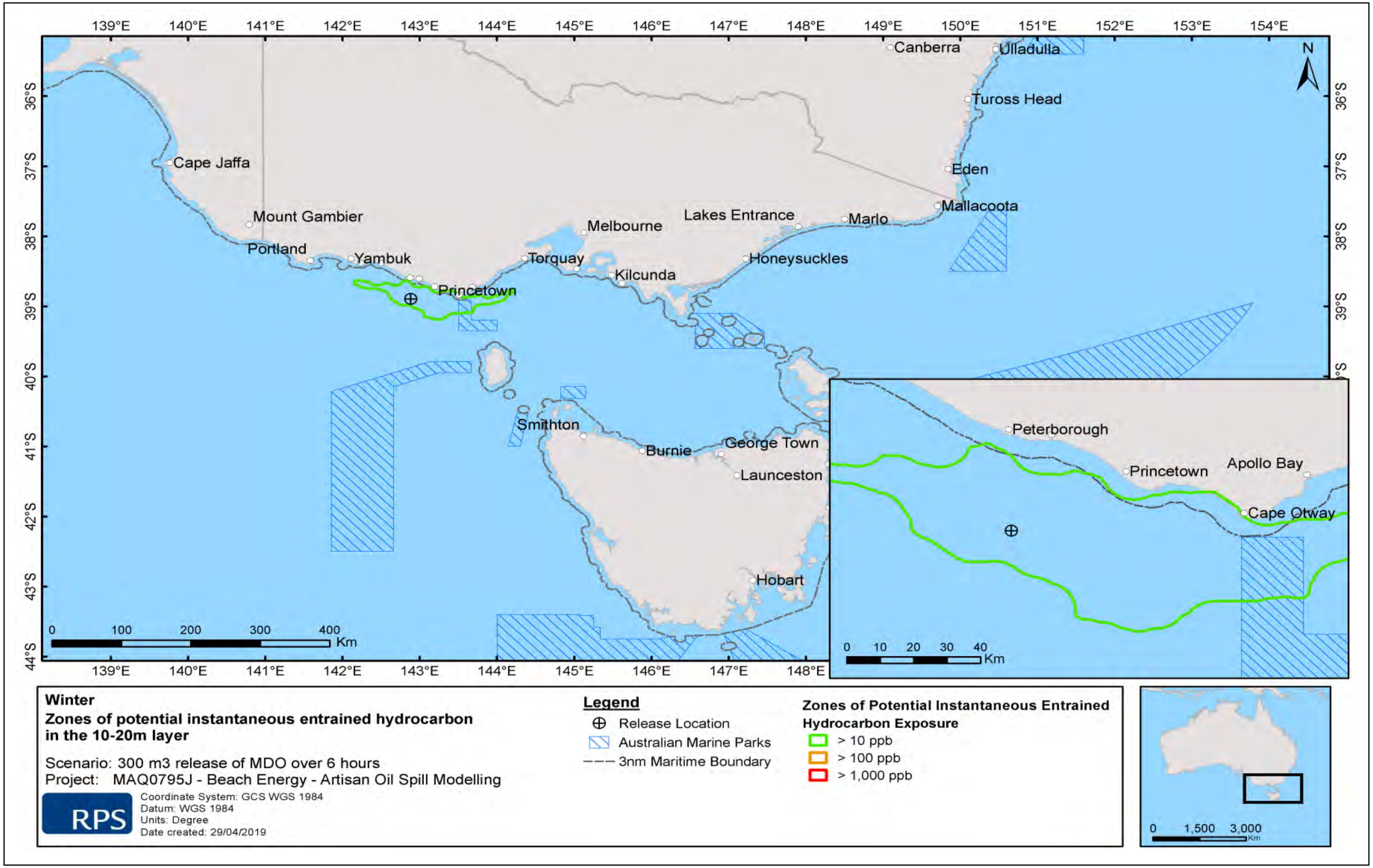


Figure 7.9. Zone of potential 1 hour entrained hydrocarbon exposure at 10–20 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (April to September) wind and current conditions.

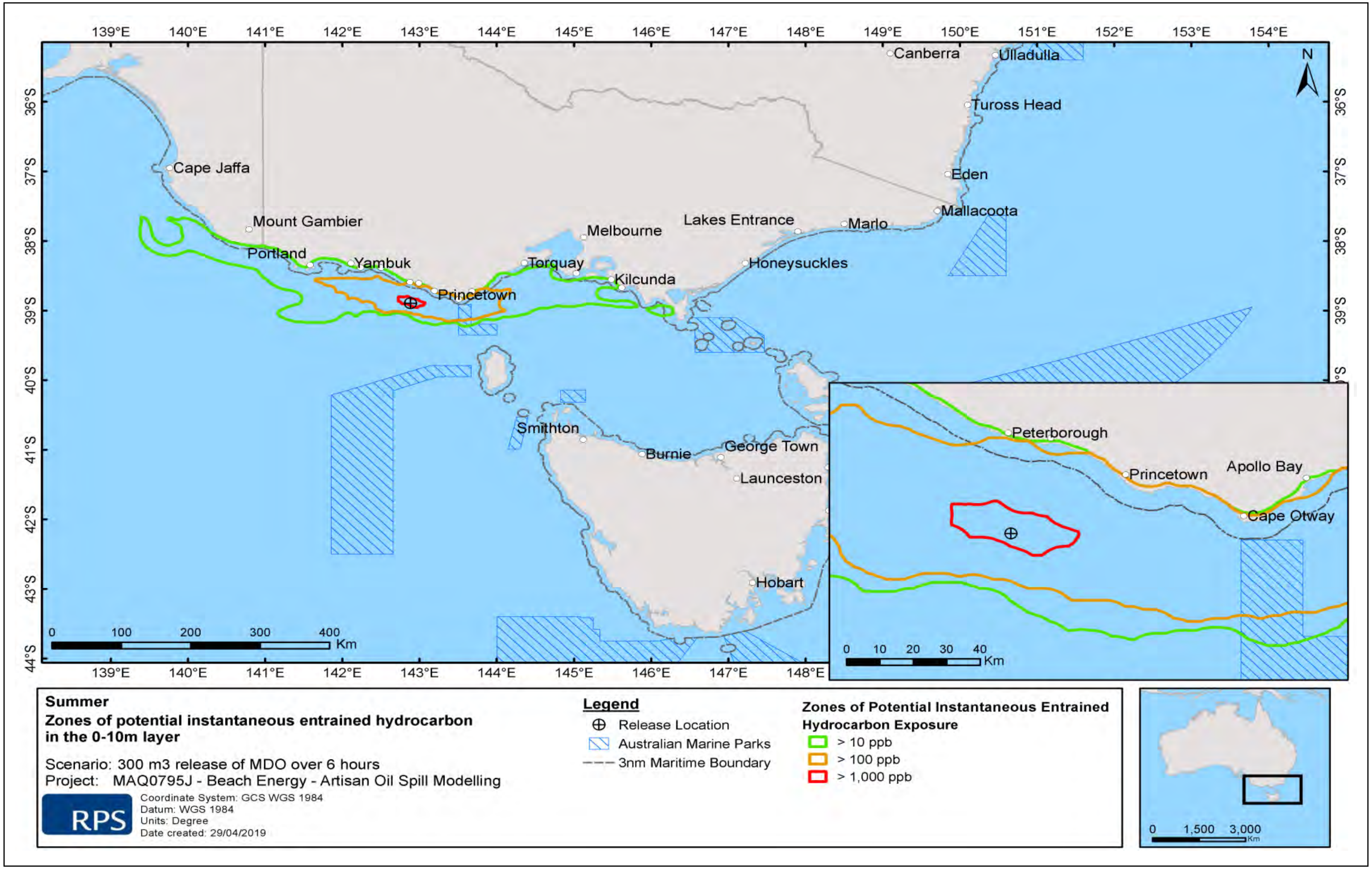


Figure 7.10. Zone of potential 1 hour entrained hydrocarbon exposure at 0–10 m below the sea surface in the event of a 300 m³ of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (October to March) wind and current conditions.

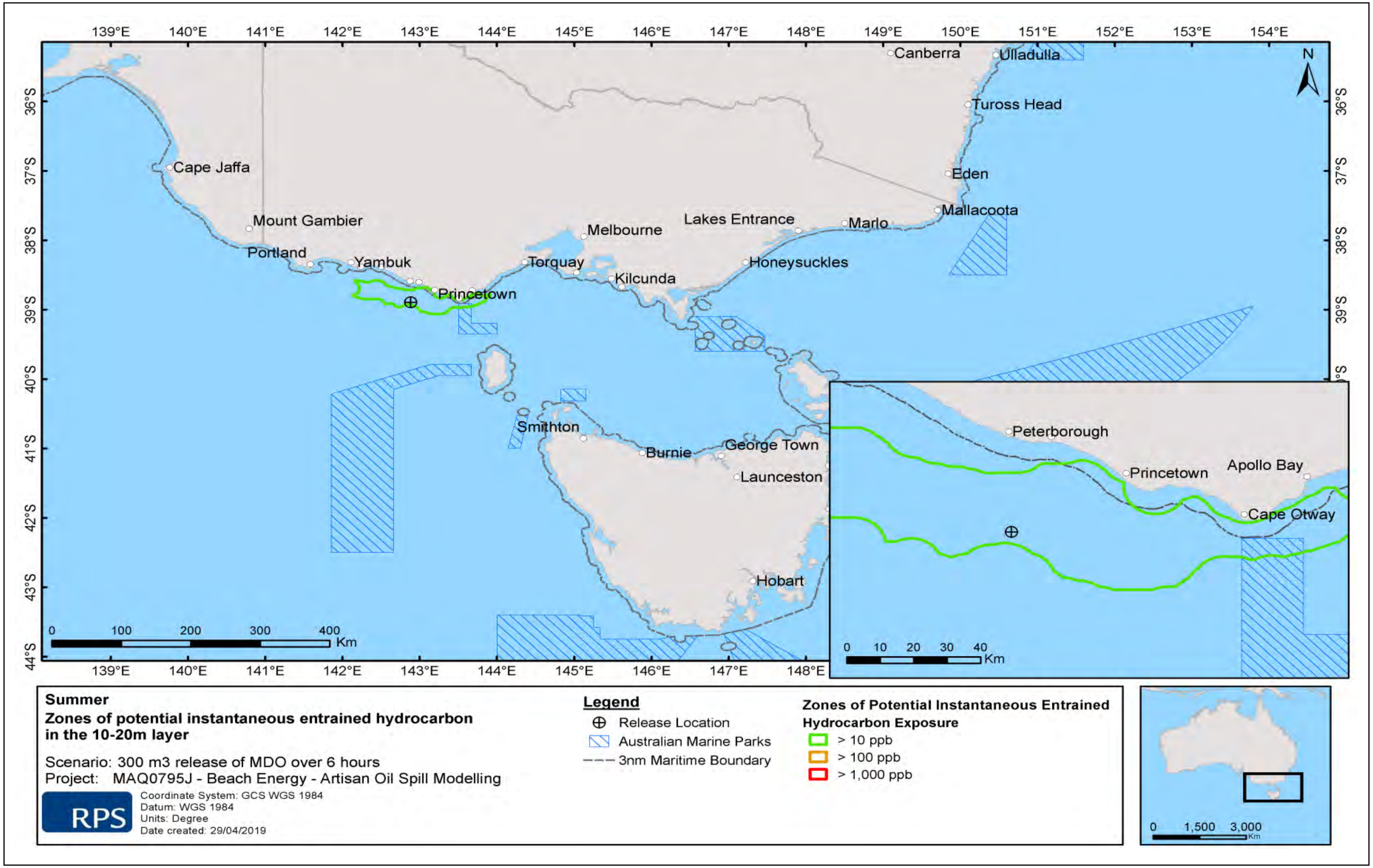


Figure 7.11. Zone of potential 1 hour entrained hydrocarbon exposure at 10–20 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (October to March) wind and current conditions.

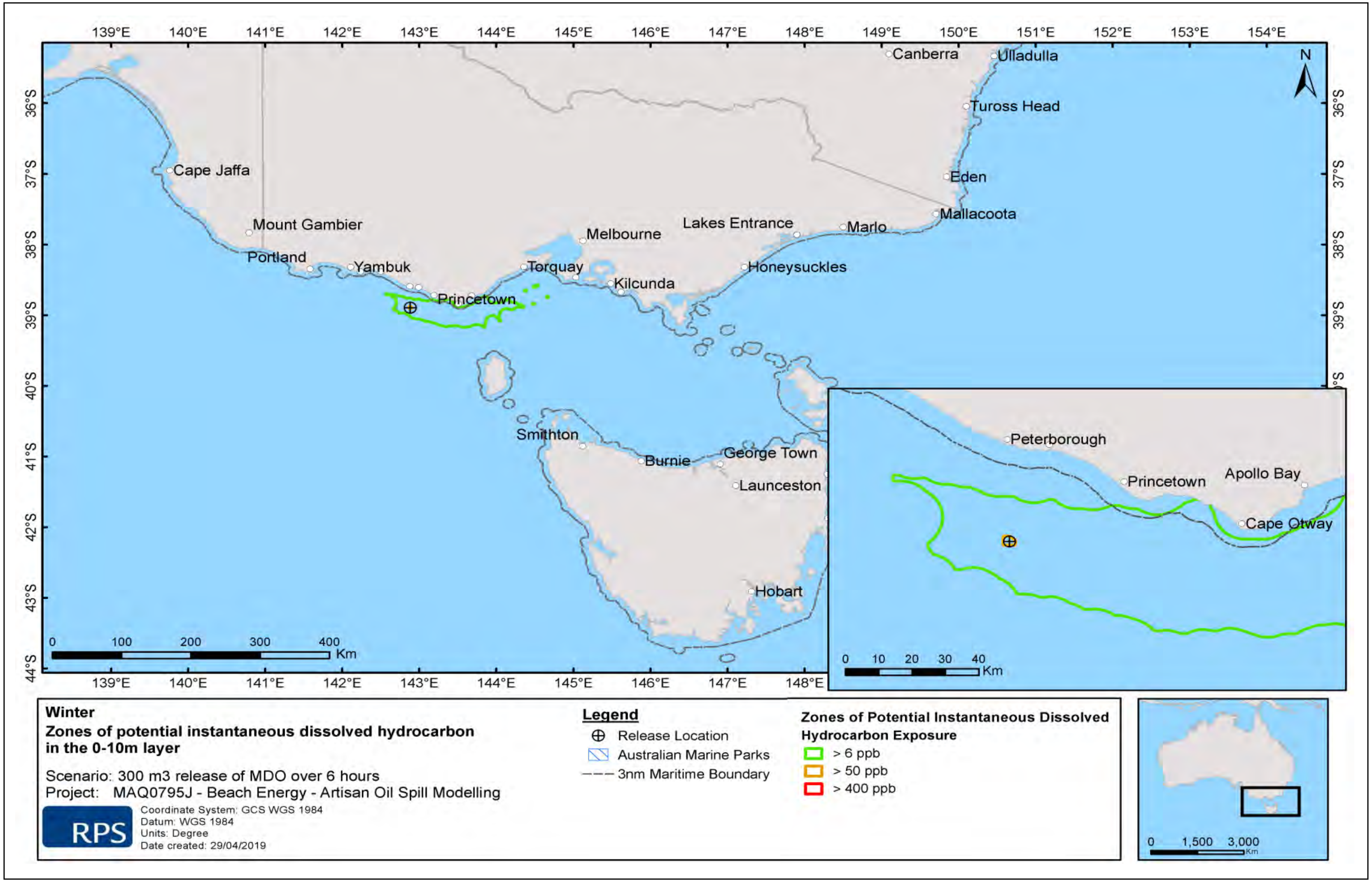


Figure 7.12. Zones of potential dissolved hydrocarbon exposure for 1 hour window at 0–10 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (April to September) wind and current conditions.

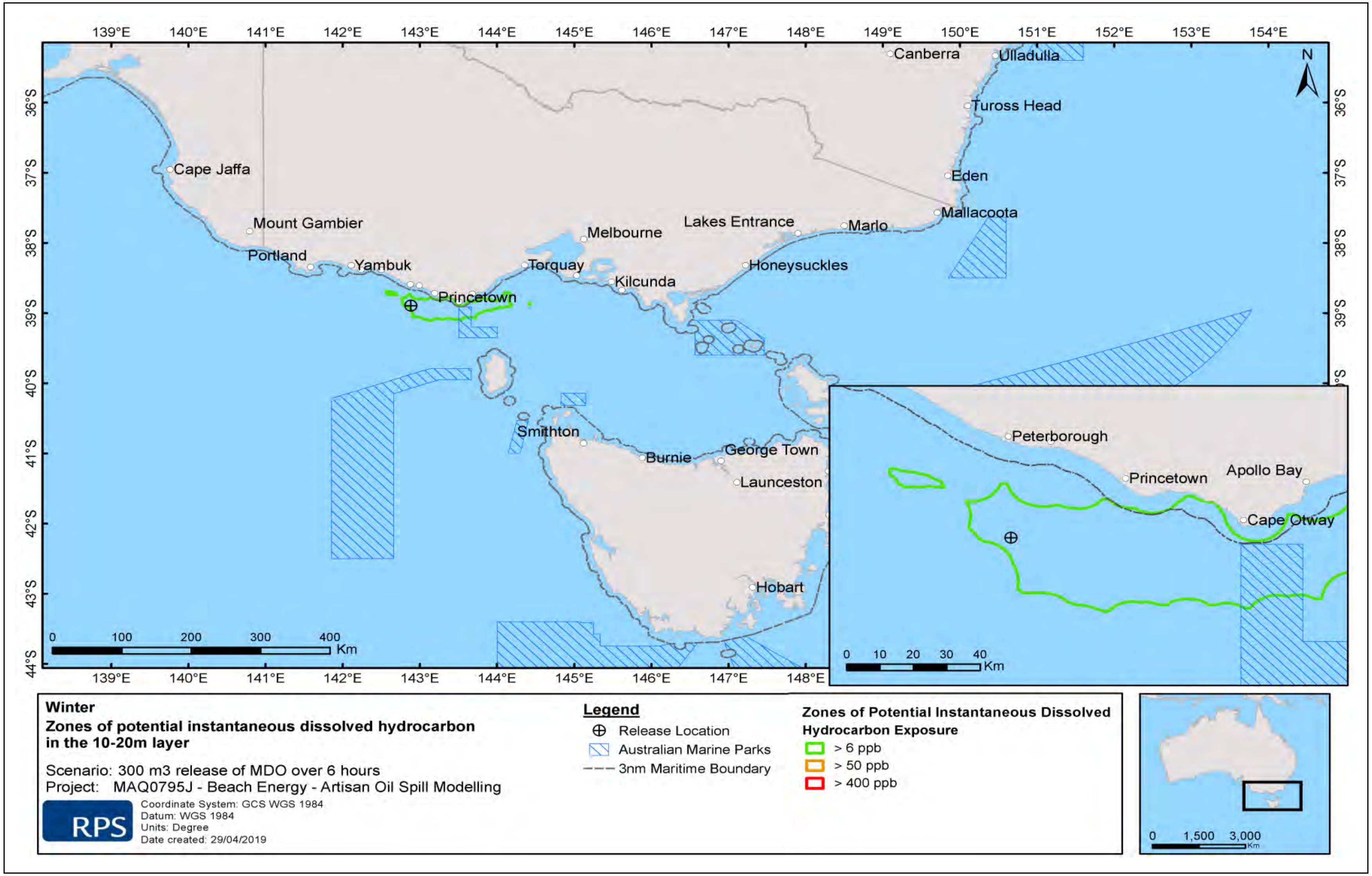


Figure 7.13. Zones of potential dissolved hydrocarbon exposure for 1 hour window at 10–20 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (April to September) wind and current conditions.

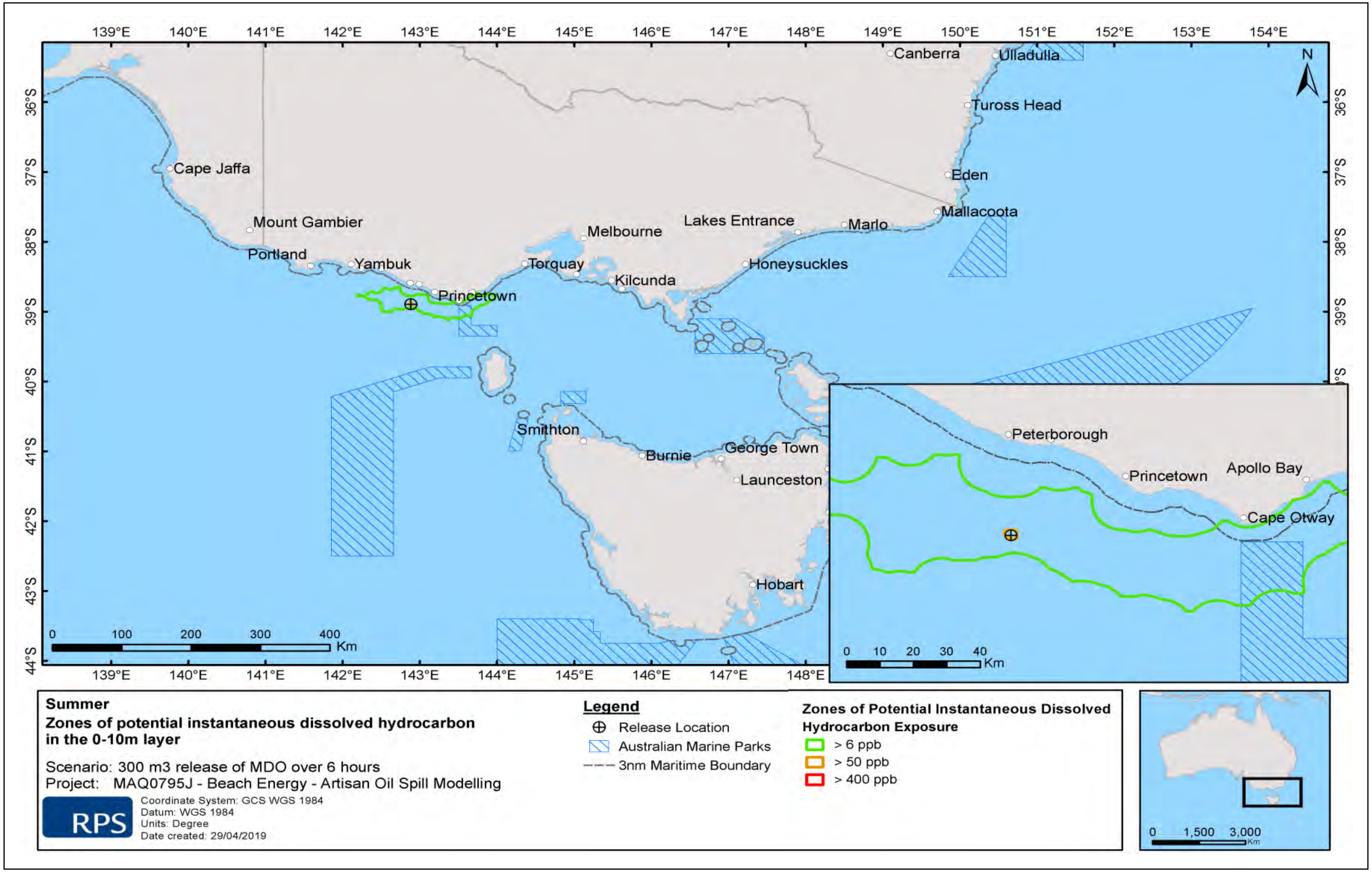


Figure 7.14. Zones of potential dissolved hydrocarbon exposure for 1 hour window at 0–10 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (October to March) wind and current conditions.

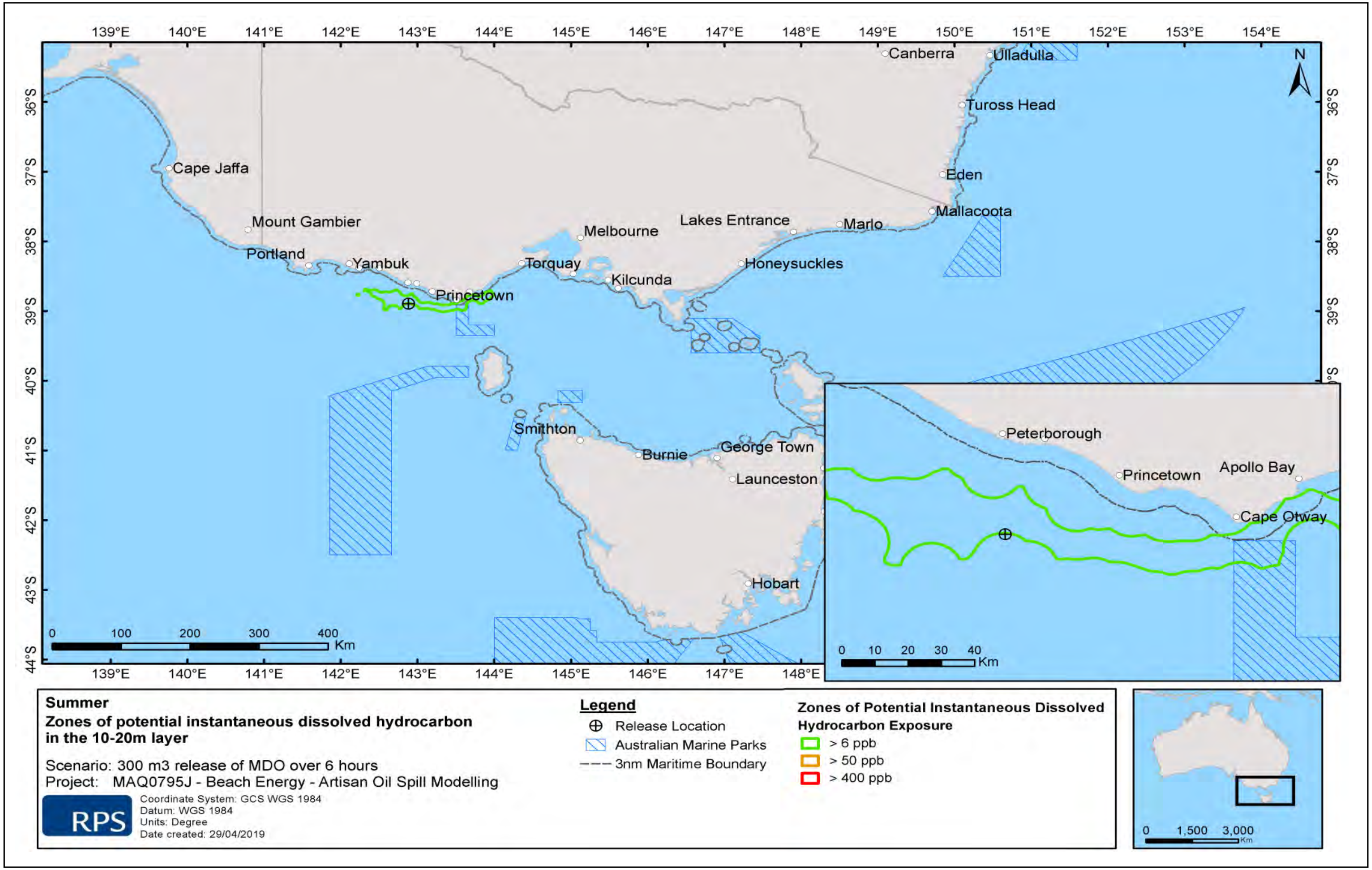


Figure 7.15. Zones of potential dissolved hydrocarbon exposure for 1 hour window at 10–20 m below the sea surface in the event of a 300 m^3 of surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (October to March) wind and current conditions.

7.14.2 Potential environmental risks

The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality;
- Injury or death of exposed marine fauna and seabirds;
- Habitat damage where the spill reaches shorelines;
- Changes to the functions, interests or activities of other users (e.g., commercial fisheries).

7.14.3 EMBA

The EMBA for a 300 m^3 spill of MDO (sea surface, entrained and dissolved hydrocarbons) is illustrated in Figure 7.3 to Figure 7.15 (excluding Figure 7.7). Receptors most at risk within this EMBA, whether resident or migratory, are:

- Plankton;
- Fish;
- Cetaceans;
- Pinnipeds;
- Avifauna; and
- Shoreline habitats.

7.14.4 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 event in open ocean areas without restricted navigation. Though shipping activity is relatively high adjacent to the activity area (see Figure 5.58), 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 determining the sensitivity of receptors at risk of an MDO are presented in Table 7.24. The impacts of MDO spills on key environmental receptors in the spill EMBA are described in Table 7.25 to Table 7.33.

Table 7.24 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.

Table 7.25. 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 risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
Not applicable.	Benthic invertebrates that may occur in the activity area include crustaceans (rock lobster, crabs) and molluscs (scallops). Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not expected. Species located in shallow nearshore or intertidal waters may be exposed to in-water hydrocarbons. Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g., crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Nearshore benthic fauna with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year. Consequently, the potential impacts and risks to benthic assemblages from a loss of MDO containment are considered to be minor and highly unlikely to result in long-term impacts.	Not applicable (no shoreline accumulation predicted).

Table 7.26. 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 5.5.3	
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. 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 risk from an MDO spill		
Sea surface	**Water column**	**Shoreline**
Emergent or floating vegetation in the intertidal and subtidal zone along the southern coast of Victoria may be exposed to low and moderate concentrations of entrained hydrocarbon. Low concentration entrained and floating hydrocarbons are not likely to impart ecological impacts on macroalgal receptors unless chronically exposed (>24 hours). Where concentrations of moderate and above occur, macroalgal communities are likely to be impacted in the manner described above. Hydrocarbons may contact the intertidal shores as the tide ebbs, but it would be expected that this would be flushed with each flood tide. Natural flushing is more likely to reduce impacts in exposed areas of shoreline. Strong wave-action, an exposed coastline and the light characteristics of MDO all assist in the rapid dispersal and dilution of the MDO, meaning that potential impacts to intertidal macroalgal communities will be minor and are highly unlikely to result in long-term impacts.		Not applicable (no shoreline accumulation predicted).

Table 7.27. 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 5.5.2	
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, 2011), allowing for seasonal influences on the assemblage characteristics.		
Potential risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
Plankton found in open water of the EMBA is expected to be widely represented within waters of the wider Bass Strait region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by 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. Consequently, given the limited area exposed by moderate exposure to dissolved and entrained hydrocarbons, the potential impacts to plankton are considered to be minor, as they could be expected to cause short-term and recoverable impacts.		Not applicable.

Table 7.28. Potential risk of MDO release on pelagic fish

General sensitivity to oiling – pelagic fish	
Sensitivity rating of pelagic fish	Low
A description of pelagic fish in the EMBA is provided in:	Section 5.5.7

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 7.27 'Plankton').

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 Gulf of Mexico (BP, 2014).

No reports of oil spills in open waters have been reported to cause fish kills (though mortality in aquaculture pens has), which is likely to be because vertebrates can rapidly metabolise and excrete hydrocarbons (Hook *et al.*, 2016).

Recovery of fish assemblages depends on the intensity and duration of an unplanned discharge, the composition of the discharge and whether dispersants are used, as each of these factors influences the level of exposure to potential toxicants. Recovery would also depend on the life cycle attributes of fishes. Species that are abundant, short-lived and highly fecund may recover rapidly. However less abundant, long-lived species may take longer to recover. The range of movement of fishes will also influence recovery. The nature of the receiving environment would influence the level of impact on fishes.

Potential risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
There is a small area in which moderate exposure and high exposure threshold hydrocarbons travel from the release site 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 an extremely small area of the sea surface in comparison to the wider Otway region. Because the majority of fish tend to remain in the mid-pelagic zone, they are not likely to come into contact with surface hydrocarbons. Consequently, the potential impact from sea surface hydrocarbons on fish species is minor.	Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, which is not likely to be exposed. 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. Therefore, any impacts are expected to be highly localised. Entrained and dissolved hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. Due to the well-mixed waters of the region, and the high and rapid rate of MDO weathering, the risk of toxicity impacts from MDO in the water column for fish is restricted to the top 10 m of water. Thus, impacts will be minor.	Not applicable.

Table 7.29. 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 5.5.5

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. As such, 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 risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
There is a very small area in which moderate and high exposure threshold hydrocarbons may travel from the release site on the sea surface. This area overlaps the foraging BIA for pygmy blue whales and known core range of southern right whales. It is possible that southern right whales may be present in the EMBA during the activity though it is unlikely for pygmy blue whales to have arrived in the region during the winter period (April to September). If present, these species (and other cetaceans) may be exposed to hydrocarbons in the manner described in this table. 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 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 approximately 40% of the spill evaporating within 1 day (depending on the prevailing wind conditions), 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 feeding in the EMBA. Consequently, impacts to cetaceans from sea surface hydrocarbons is minor.	Impacts to cetaceans are likely to be limited to the areas of moderate and high exposure to entrained hydrocarbons. This area is predicted to be limited to western 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. 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. Consequently, impacts to cetaceans from high threshold hydrocarbons in the water column is considered moderate in the short-term.	Not applicable.

Table 7.30. 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 5.5.6

Pinnipeds (Australian fur-seal and New Zealand fur-seal) 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 litre of oil to be at risk.

Volkman et al (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver considered likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death.

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 (2011) 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).

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 risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
The foraging range for Australian and New Zealand fur-seals may be temporarily exposed to a very small area of moderate to high exposure thresholds of hydrocarbons at the sea surface. High threshold exposure is considered to be damaging to pinnipeds through either direct contact or ingestion of contaminated prey species. MDO at the sea surface spreads thinly and weathers quickly, reducing the amount of time that fur-seals may be exposed to MDO. 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 surface or entering and exiting the water. Sea surface oil >10 g/m^2 is only predicted for the first 36 hours of the spill, thereby limiting the period when oiling may occur. Therefore, potential impact would be limited to individuals, with population impacts not anticipated. Consequently, the potential impacts and risks to seals are considered to be minor, as they could be expected to result in only localised short-term impacts to species of recognised conservation value.	Given that fur-seals forage for prey within the water column, exposure to harmful concentrations of entrained hydrocarbons may occur in the 0-10 m depth layer (either via ingestion of contaminated prey or direct contact with oil droplets), though at generally low concentrations across the EMBA. Consequently, the potential impacts and risks to seals are considered to be minor, as they could be expected to result in only localised short-term impacts to species of recognised conservation value.	Not applicable (no shoreline accumulation predicted).

Table 7.31. 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:

1. Internally – eating or swallowing oil, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds; and
2. Externally – swimming in oil or dispersants, or oil or dispersants on skin and body.

Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Short, 2011). An exception to this was the large number of marine turtles collected (613 dead and 536 live) during the Macondo spill in the Gulf of Mexico, although many of these animals did not show any sign of oil exposure (NOAA, 2013). Of the dead turtles found, 3.4% were visibly oiled and 85% of the live turtles found were oiled (NOAA, 2013). Of the captured animals, 88% of the live turtles were later released, suggesting that oiling does not inevitably lead to mortality.

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 risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
Some individual transient marine reptiles may come into contact with localised areas of high MDO exposure on the sea surface and in the top 0-10 m of the water column. However, this high concentration is small in area and temporary in duration. Due to the absence of turtle BIAs in Victoria and the low chance of encountering turtles in Victorian waters in general, the potential impacts and risks to marine turtles are minor, as they could be expected to result only in localised and short-term impacts.		Not applicable (no shoreline accumulation predicted).

Table 7.32. 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 5.5.4

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, 2011).

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, 2011). A bird suffering from cold, exhaustion and a loss of buoyancy (resulting from fouling of plumage) may dehydrate, drown or starve (ITOPF, 2011; DSEWPC, 2011a). 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, 2011a). 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, 2011). Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbons consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. 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 risk from an MDO spill		
Sea Surface	**Water column**	**Shoreline**
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 time that birds are potentially exposed to toxic concentrations of hydrocarbons (see Figure 7.5). Consequently, the potential impacts and risks to seabirds from a loss of MDO containment are considered to be moderate, as they could be expected to result in localised short-term impacts to formally managed species/habitats of recognised conservation value.	The seabirds known to occur in the EMBA would spend only seconds at a time diving for fish in the top 0-10 m of the water column. Consequently, contact with MDO at high exposure levels would be brief (even after numerous dives) and the potential impact of toxicity effects to birds is minor.	Not applicable (no shoreline accumulation predicted).

Table 7.33. 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 5.7.6

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 (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 Gulf of Mexico since 2011 were generally consistent with pre-spill ranges and for many shellfish species, commercial landings in the Gulf of Mexico in 2011 were comparable to pre-spill levels. In 2012, shrimp (prawn) and blue crab landings were within 2.0% of 2007-09 landings. 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 risks from MDO spill			
Fishery	**Surface oiling**	**Water column**	**Shoreline**
General	A short-term fishing exclusion zone may be implemented by AFMA, the VFA and/or DPIPWE. Given	OSTM predicts large areas may be exposed to dissolved and entrained hydrocarbons at the low exposure threshold, and	Not applicable.

	the temporary nature of any surface slick and the small area potentially subject to surface MDO, there are unlikely to be any long-term impacts on fisheries in terms of lost catch (and associated income).	smaller areas at the moderate and high 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.	
Victorian fisheries (those known to fish within the EMBA)			
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 exposure 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 or its catch species. This is expected to be of minor consequence to the overall long-term function of the fishery or its catch species.	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.	The OSTM indicates the maximum extent of moderate exposure of the benthic layer to entrained hydrocarbons occurs in the nearshore environment at the southern tip of 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 long-term function of the fishery or its catch species.	As per 'general'.
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.	The OSTM indicates the maximum extent of moderate exposure of the benthic layer to entrained hydrocarbons occurs in the nearshore environment at the southern tip of Cape Otway. Low exposure entrained hydrocarbons intersect large areas of the	As per 'general'.

		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 long-term function of the fishery or its catch species.	
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 long-term function of the fishery or its catch species.	As per 'general'.
Ocean purse seine	No impacts due to their pelagic habitat. Vessel hulls have a low risk of accumulating hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	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 exposure 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 long-term function of the fishery or its catch species.	As per 'general'.
Ocean access			As per 'general'.
Commonwealth fisheries (those known to fish within the EMBA)			
Southern squid jig	The most heavily fished areas of the fishery are located off the east coast of Tasmania, which is not intersected by the EMBA. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have a significant impact on the overall long-term function of the fishery or its catch species and is therefore considered to have a minor consequence.		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 intersected by the EMBA. The EMBA intersects areas of low and medium intensity fishing. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have a significant impact on the overall long-term function of the fishery or its catch species and is therefore considered to have a minor consequence.		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. The EMBA intersects a small area of low fishing intensity. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have a significant impact on the overall long-term function of the fishery or its catch species and is therefore considered to have a minor consequence.	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 a significant impact on the overall long-term function of the fishery or its catch species and is therefore considered to have a minor consequence.	Not applicable.

7.14.5 Risk assessment

Table 7.34 presents the risk assessment for an MDO spill.

Table 7.34. 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 Figures 7.14, 7.16, 7.17 and 7.18.		
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
Pelagic fish	Minor	Highly unlikely	Low
Cetaceans	Moderate	Highly unlikely	Low
Pinnipeds	Minor	Highly unlikely	Low
Marine reptiles	Minor	Highly unlikely	Low
Seabirds	Minor	Highly unlikely	Low
Shorebirds	Moderate	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		
No MDO is spilled at sea during refuelling activities.	No vessel refuelling is undertaken at sea (this will be done in port).	Bunker log verifies that refuelling was undertaken in port.
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: o *Navigation Act* 2012 (Cth), Chapter 3, Part 3 (Seaworthiness of vessels).	Vessel audit/assurance reports (prepared or commissioned by Beach) verify that vessels contracted to Beach meet legislative safety requirements.

	o Marine Order 21 (Safety and emergency arrangements). o Marine Order 30 (Prevention of Collisions). o 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.	
	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.
Vessel crews are prepared to respond to a spill.	An approved SMPEP is implemented in the event of a large MDO spill.	Current SMPEP is available
		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
Cetaceans	Minor	Remote	Low
Pinnipeds	Minor	Remote	Low
Marine reptiles	Minor	Remote	Low
Seabirds	Minor	Remote	Low
Shorebirds	Minor	Remote	Low
Commercial fisheries	Minor	Remote	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.

Good practice	
Avoid/Eliminate	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.
Change the likelihood	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.
Change the consequence	

	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.		
Reduce the risk	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.		
Engineering risk assessment			
The OSTM undertaken for the MDO spill scenario is an engineering risk assessment and supports the development of the EPS listed in this table.			
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.	
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 stakeholders about MDO spills 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). • *OPGGS Act* 2006 (Cth): o Section 572A-F (Polluter pays for escape of petroleum). • OPGGS(E): o Part 3 (Incidents, reports and records). • *Protection of the Sea (Prevention of Pollution by Ships) Act* 1983 (Cth): o Section 11A (SOPEP). • *Environment Protection Act* 1993 (SA); • *Pollution of Waters by Oil and Noxious Substances Act* 1987 (Tas); • *POWBONS Act* 1986 (Vic) o • 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	Guidelines met with regard to:	

	Oil and Gas Development (World Bank Group, 2015)	• 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 (Section 5.5.1)	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 Tables 7.59 to 7.66, the consequence of an MDO spill on these receptors is minor and unlikely to result in long-term ecological impacts. See Appendix 1 for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	There is a low probability of low exposure entrained hydrocarbons intersecting small portions of the Westernport and Port Phillip Bay and Bellarine Peninsula Ramsar sites. At this exposure concentration, the values of these wetlands will not be affected in the long-term.
	TECs (Section 5.5.6)	Entrained hydrocarbons at the low threshold of exposure may intersect the Giant Kelp Forests of South East Australia on the southwestern coast of Victoria. 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: • Aire River • Princeton Wetlands; • Lake Connewarre State Wildlife Reserve; • Swan Bay & Swan Island; • Mud Islands; and • Westernport. 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

	(Section 5.4)	tables in this section, the risks to individuals or populations of threatened and migratory species are mostly low.
	Other matters	
	State marine parks (Sections 5.4.9, 5.4.10 & 5.4.11)	The MDO EMBA intersects the following state marine parks: • The Arches MNP; • Twelve Apostles MNP; • Marengo Reefs Marine Sanctuary; • Point Addis MNP; • Port Phillip Heads MNP • Bunurong MP/MNP; • Wilsons Promontory MP/MNP. See Appendix 1 for additional detail regarding the impacts of non-routine activities on the management aims of these state marine parks.
	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, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. See Appendix 2 for additional detail regarding the impacts of non-routine activities on the management aims of threatened species 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 the OPEP and OSMP.

Record Keeping

- Vessel assurance reports.
- Notice to Mariners.
- Stakeholder consultation correspondence and register.
- SMPEP.
- OPEP.
- ERP.
- Crew training records.
- Bunkering procedure.
- Bunkering PTWs, JSAs, inspection checklists.
- Oil spill response exercise records.
- Inspection/audit reports.
- Incident reports.

7.15 RISK 6 - 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 7.35 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 7.35. 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. 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**	No

Response option	Feasibility and effectiveness analysis	Adopt?
	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 threshold, 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** No shoreline loading is predicted in the OSTM. Therefore, no 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** No 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 7.35 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.

7.15.1 Scope of Activity

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.

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).

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.

7.15.2 Availability

Monitor and Evaluate

Beach (through its membership with AMOSC), the DJPR (Emergency Management Branch, EMB), DPIPWE (EPA Tasmania) and the South Australian Department for Transport and Infrastructure (DIT) maintain operational monitoring capability as outlined in Table 7.36.

Table 7.36. Resources available for monitoring and evaluation

Resource required	Beach resources	DJPR (EMB) resources	DPIPWE (EPA Tasmania resources)	DIT resources
Aviation	Beach will activate its contract with AMOSC to access helicopter	Access to Emergency Management Victoria's (EMV's) State Aircraft Unit.	A Memorandum of Understanding between the	The Country Fire Service (CFS), State Emergency Service

Resource required	Beach resources	DJPR (EMB) resources	DPIPWE (EPA Tasmania resources)	DIT resources
	and/or fixed aircraft to assist in spill monitoring.	Air support can be mobilised within 4 hours of request. Additionally, NatPlan resources can be activated.	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.	(SES) and the Department for Environment and Water (DEW) are capable of deploying air observers, depending on the location of the spill. Additional resources are available through AMSA and the National Plan.
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.		

Assisted Natural Dispersion

The same VoO outlined under 'monitor and evaluate' would be used to implement assisted natural dispersion.

7.15.3 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.

7.15.4 Impacts and Risks of the Response Activities

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.

7.15.5 Evaluation of Environmental Impacts and Risks

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.

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.

7.15.6 Environmental Impact and Risk Assessment

Table 7.37 presents the risk assessment for hydrocarbon spill response activities

Table 7.37. 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, protection and deflection 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, 2017) 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 7.33 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 Change the consequence	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. 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 (Chapter 4)	Beach has undertaken open and honest communications with all stakeholders, and actively involved stakeholders known to have concerns with activity. Stakeholders have not raised concerns about hydrocarbon spill response activities.	

Legislative context
(see Sections 2.2, 2.3 & 2.4 for descriptions of relevant legislation)
	The performance standards outlined in this EP align with the requirements of:
	• *OPGGS Act* 2006 (Cth) and OPGGS(E) (Cth):
	  o Part 6.2 – directs the polluter to take actions in response to an incident and to clean up and monitor impacts.
	  o Regulation 13(5) (Risk assessment undertaken to demonstrate ALARP).
	• EPBC Regulations 2000 (Cth):
	  o 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 (see Sections 2.7 & 2.8 for descriptions)	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.
	South Australia Marine Spill Contingency Action Plan (SAMSCAP) (DPTI, 2016)	DIT will implement this plan in the event their resources are deployed. The EPS listed in this table complement the SAMSCAP.
	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, 2011a).	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.
	Aerial Observations of Oil Spills at Sea (IPIECA/OGP, 2015).	
Environmental context	MNES	
	AMPs (Section 5.5.1)	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. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.5.4)	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 (Section 5.5.6)	Spill response will not be undertaken in areas where TECs exist. Vessel or aircraft-based monitoring activities will have no impacts on TECs.
	NIWs (Section 5.5.8)	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 (Section 5.4)	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 (Sections 5.4.9, 5.4.10 & 5.4.11)	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. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	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. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans. 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.
- Equipment and service provider register.
- Exercise drill reports.
- Inspection/audit reports.
- Incident and daily operations reports.
- Operational NEBA.
- Briefing records.
- Photos.
- OSMP implementation records and 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 (see 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

The activity will be undertaken in accordance with the Beach OEMS. The OEMS documents the Environmental Policy, 11 OEMS Elements, HSE Procedures and the key HSE processes and requirements for activities where Beach is the titleholder. 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 has been developed based on the IOGP Operating Management System Framework and is aligned with the requirements of recognised international and national standards including:

- ISO 14001 (Environmental Management);
- ISO 31000 (Risk Management); and
- ISO 45001 (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 (provided in Figure 2.1) and management of potential HSE impacts and risks (Table 8.1 and Figure 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 of the CSV 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.

Table 8.1. Beach OEMS 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
		Finance 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 8.1. The Beach OEMS

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 CEO has the ultimate responsibility for ensuring that Beach has the appropriate organisation in place to meet the commitments established within this EP. 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 and responsibilities of key project members are summarised in Table 8.2.

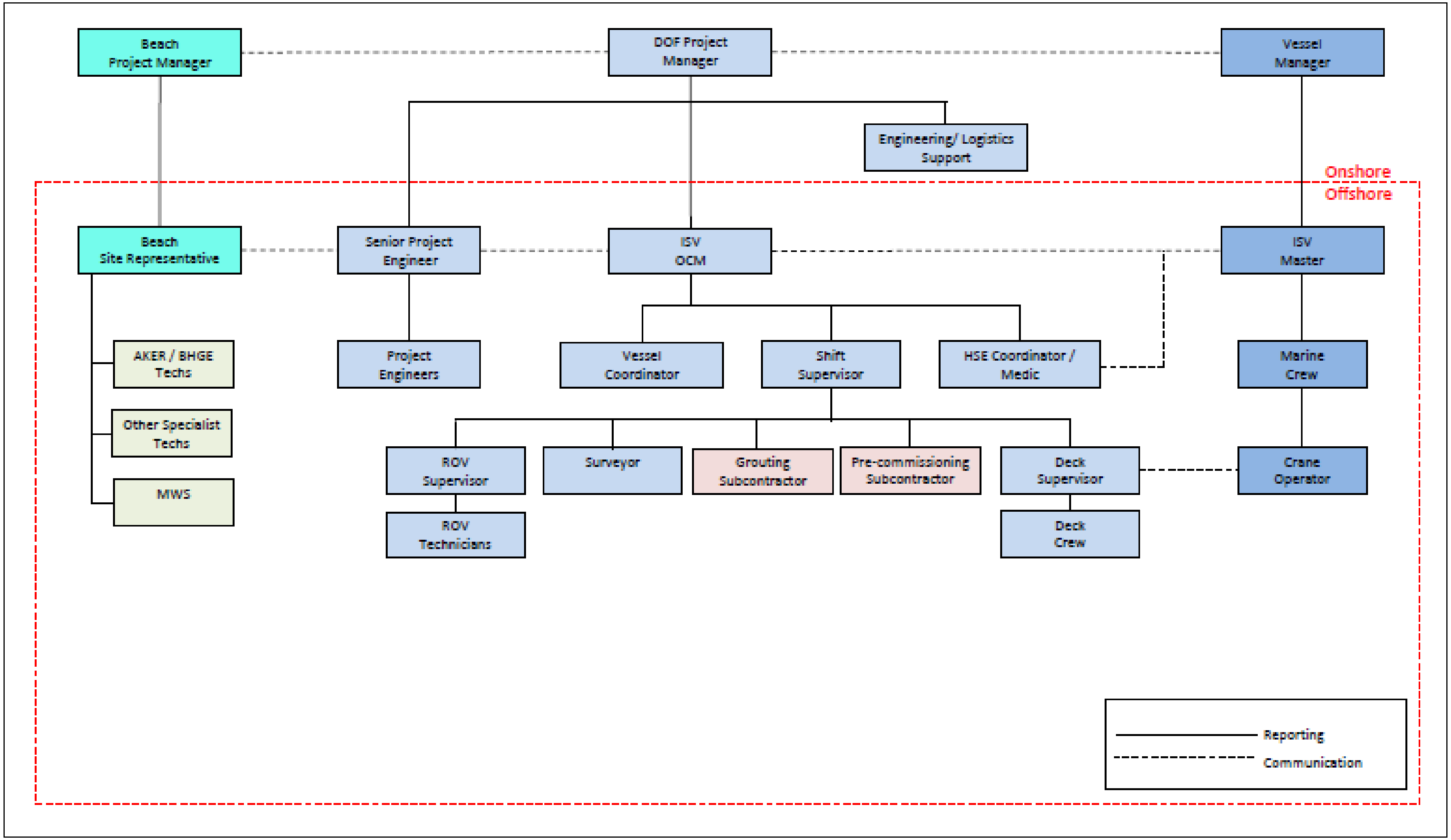


Figure 8.2. Geographe subsea installation organisation chart

Table 8.2. Activity roles and key environmental responsibilities

Role	Key environmental responsibilities
Onshore	
Beach 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. • The 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 8.10.1. • The EP environmental performance report is submitted to NOPSEMA not within three months of activity completion. • Any changes to equipment, systems and documentation where there may be a new, or change to, an environmental impact or risk or a change that may impact the EP are assessed in accordance with the MoC process detailed in Section 8.8.1. • Oil spill response arrangements for the activity are tested as per Chapter 9. • Ensure audits and inspections are undertaken in accordance with Section 8.12.
Beach Principal Environment Advisor (offshore)	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. • Any new or changed environmental impact or risk or a change that may impact the EP is reviewed and documented as per Section 8.12. • That audits and inspections are undertaken as detailed in Section 8.12 and any actions from non-conformances or improvement suggestions tracked. • Reviews and revisions to the EP are made as per the requirements in Section 8.12.
Beach Community 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	Key environmental 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 8.12. • Emissions and discharges identified in Section 8.12 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 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. • Emissions and discharges identified in Section 8.12 are recorded and provided to the Beach Offshore Representative. • 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. • Oil spill response arrangements are in place and tested as per the vessel's SMPEP. • General and hazardous wastes are backloaded to port for disposal to a licenced waste facility.
Vessel personnel	All vessel crew are responsible for: • Completing the Beach HSE induction. • Reporting fauna sightings and interactions to the MMOs. • Reporting hazards and/or incidents via company reporting processes. • Adhering to vessel's HSEMS and this EP 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 (see 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 (see 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 hazard assessed in Chapter 7 specifically details the legislation pertaining to each hazard.

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 (see 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 vessel personnel will complete a activity-specific environmental induction. Records of completion of the induction will be recorded and maintained. The induction will cover (but is not limited to):

- Description of the environmental sensitivities and conservation values of the activity area;
- 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; and
- Overview of emergency response and spill management plans and vessel interaction procedures.

In addition to the activity-specific induction, each person 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 have 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

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 (see Table 8.1) and four outcomes to be delivered under this element.

Chapter 3 details how the vessel contractor will be assessed to ensure they have the capabilities and competencies to implement the control measures identified in Chapter 7. Training and competency of contractor personal engaged to work on the activity shall be managed in accordance with the contractor's HSEMS (or equivalent).

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 (see Table 8.1) and eight outcomes to be delivered under this element.

Nevertheless, plant and 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 of the plant and/or equipment 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 (see Table 8.1) and ten outcomes to be delivered under this element. The standard of relevance to this EP is briefly 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 hazards, controls or risk (compared to those described and assessed in Chapter 7), 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 (see Table 8.1) and seven outcomes to be delivered under this element. The standards of relevance to this EP are briefly 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 6 and applied to all the hazards assessed in Chapter 7 of this EP.

As described in Section 8.12, 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.

The emergency response framework to be applied to the activity is outlined below.

Emergency Response Framework

The Beach Crisis and Emergency Management Framework consists of a tiered structure whereby the severity of the emergency triggers the activation of emergency management levels. The emergency response framework contains three tiers based on the severity of the potential impact, as outlined in Figure 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.

<u>Emergency Response Plan</u>

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.

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 CMT if required.
EMT	Melbourne office (or Adelaide office, depending on roster)	• Provide operational management support to the ERT to contain and control the incident. • Implement the Business Continuity Plan. • Liaise with external stakeholders in accordance with the Bridging ERP. • Regulatory reporting.
ERT	Activity vessel	• Respond to the emergency in accordance with the site-specific ERP (e.g., SMPEP).

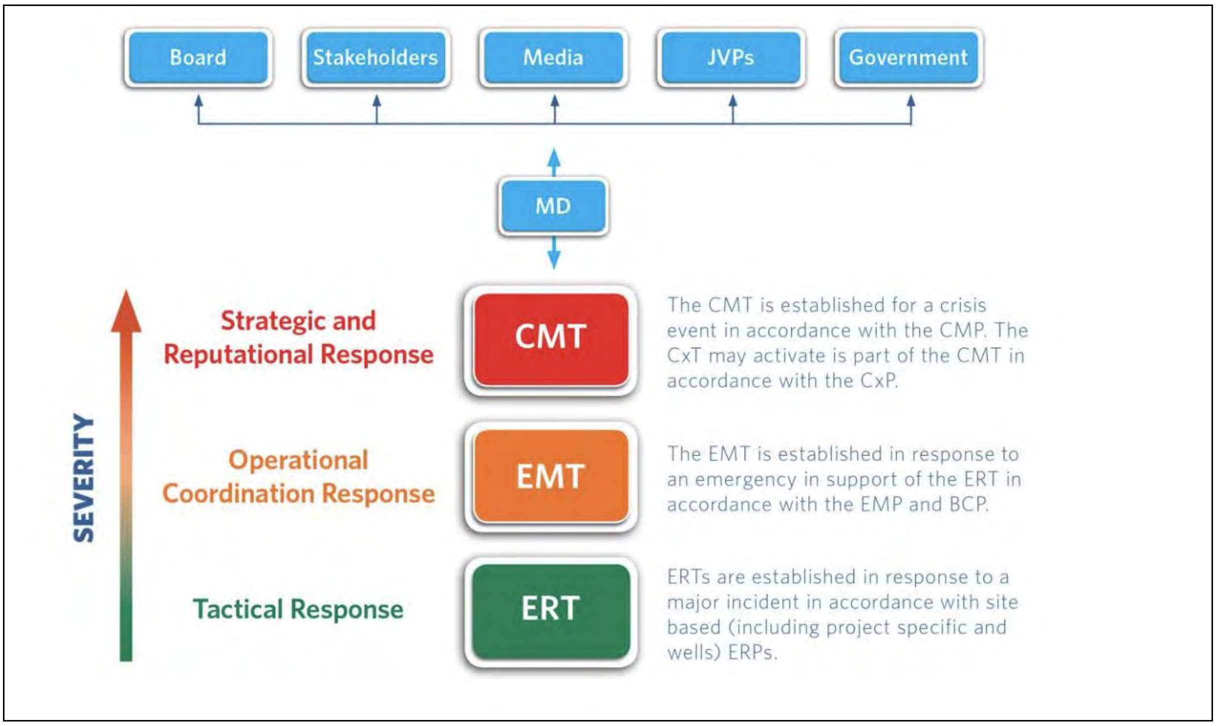


Figure 8.3. Beach Crisis and Emergency Management Framework

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).

8.9.3 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 operational 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 (see 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.

The recordable and reportable incident types are described in this section.

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

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 4 – Introduction of IMS.

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 • DTI (SA) - 8248 3505
	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 • DEW (SA) - (08) 8204 1910
	Suspected or confirmed IMS introduction	• DELWP – 136 186 (24 hrs) • DAWE - 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) • DAWE – 1800 803 772 • Whale and dolphin emergency hotline – 1300 136 017 • AGL marine response unit – 1300 245 678
Written notification		
Not later than 3 days after the first occurrence of the incident	A written incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent similar recordable incidents occurring in the future.	• NOPSEMA – submissions@nopsema.gov.au
Within 72 hours of the incident	As above, with regard to details of a vessel strike incident with a cetacean	• Upload information to DAWE online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike)

Timing	Requirements	Contact
		• DELWP (Whale and Dolphin Emergency Hotline) – 1300 136 017 • Seals, Penguins or Marine Turtles – 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678.
Within 7 days of the incident	As above, with regard to impacts to MNES, specifically injury to or death of EPBC Act-listed species	• EPBC.Permits@environment.gov.au • DAWE 1800 803 772
Within 7 days of providing written report to NOPSEMA	As above.	• NOPTA – reporting@nopta.gov.au

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.

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 (see 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 HSEMS standard. The key environmental management issue for this activity is managing IMS risks, discussed below.

Beach Domestic IMS Biofouling Risk Assessment Process

Scope

All vessels and submersible equipment mobilised from international or domestic waters to undertake the activity within the activity area must complete the Beach Introduced Marine Species Management Plan (S4000AH719916) vessel risk assessment process and complete the associated checklist prior to the initial mobilisation into the activity area.

The Beach Introduced Marine Species Management Plan 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 (see Section 7.12.5).

Purpose

- Validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in the activity within the activity area;
- Identify the potential IMS risk profile of vessels and submersible equipment 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 vessel or submersible equipment 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 State legislation must be met;
- If mobilising from a high or uncertain risk area, the vessel/submersible equipment must have been within that area for fewer than 7 consecutive days or inspected and deemed low risk by an independent IMS expert, within 7 days of departure from the area;
- Vessels must have valid antifouling coatings based upon manufacturers specifications;
- Vessels must have a biofouling control treatment system in use for key internal seawater systems; and
- Vessels must have a Biofouling Management Plan and record book consistent with the 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/submersible equipment 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/submersible equipment 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/submersible equipment includes:

- Age, type and condition of the vessel/submersible equipment;
- Previous cleaning and inspection undertaken and the outcomes of previous inspections;
- Assessment of internal niches with potential to harbour IMS;
- Vessel/equipment history since previous inspection;
- Origin of the vessel/submersible equipment including potential for exposure to IMS;
- Translocation risk based upon source location in relation to activity location – both in relation to the water depth/proximity to land at the point of origin and the potential survivorship of IMS from the point of origin to the activity area;
- 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 deemed 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. Wherever possible, concerns expressed by stakeholders have been addressed throughout the 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 (see 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.

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 8.7.

Table 8.7. Summary of environmental monitoring

Aspect	Monitoring parameter	Frequency	Record
Impacts			
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

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 8.8 outlines the routine reporting obligations that Beach will undertake with external organisations.

Table 8.8. External routine reporting obligations

Requirement	Timing	Contact details	OPGGS(E) regulation
Pre-activity			
Notify AMSA in order to issue daily AusCoast warnings.	Within 24 hours of activity starting.	rccaus@amsa.gov.au	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 DAWE.	Within 3 months of activity completion.	Upload via the online Cetacean Sightings Application at: https://data.marinemammals.gov.au/nmmdb	N/A – EPBC Act

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 8.9.

Table 8.9. 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).

<u>Minor EP Revisions</u>

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.

Inspections and Audits

Various inspections and audits will be undertaken for the activity using competent personnel, as outlined in Table 8.10.

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 8.10. 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).

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.

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 communications, inspections and audits, as outlined in this chapter.

8.13 Summary of Implementation Strategy Commitments

Table 8.11 summarises the commitments provided throughout this Implementation Strategy by assigning EPOs, EPS and measurement criteria to each commitment.

Table 8.11. 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	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	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.
8.12.1	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	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	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.
		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.

Section	EPO	EPS	Measurement criteria
8.12.1	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	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 9.4 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 300 m^3 of MDO has been undertaken and the risks assessed (Section 7.13). 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:

- 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 EMP (described in Section 8.9.2);
- 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; and

- 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.
- The South Australian Marine Spill Contingency Plan (SAMSCAP) (DPTI, 2016) – the Department of Transport and Infrastructure is the Control Agency for spills from vessels that affect South Australian State Waters.

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 South Australian Arrangements

In the event that an MDO spill crosses into South Australian state waters, the DTI will assume Incident Control over the impacted area in state waters while AMSA will remain responsible for managing the spill outside South Australian coastal waters.

The South Australian Oiled Wildlife Response Plan is administered by the Department for Environment and Water and outlines priorities and procedures for the rescue and rehabilitation of oiled wildlife.

9.1.5 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:

1. Make the area safe;
2. Stop the leak (source control); and
3. 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).

9.2 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 9.2.1 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 (see Section 7.14). 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 7.14. 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
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
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

Notification timing	Authority	Notification By	Contact Number	Details
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
ASAP – if spill affects SA Waters	DTI	AMSA/ Beach PM	08 8248 3505	Verbally notify DTI 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 9.6.2).
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.

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).

9.5 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).

9.6 Hydrocarbon Spill Monitoring

Beach will implement a monitoring program that reflects the scale and potential effects of the spill. To this effect, Beach has in place an Operational and Scientific Monitoring Program (OSMP) (CDN/ID S4100AH717908) that can be rapidly activated in the event of a large scale MDO spill.

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.

9.6.1 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.

9.6.2 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 Study	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.

Scientific Monitoring Study	Objectives	Initiation triggers	Termination criteria
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) 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 subtidal habitat 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.
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	Determine the presence of, and recovery from, oil taint in commercially or	• The EMT Environment Leader (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred **and** data from	• The EMT Environment Leader (or delegate) considers that: ◦ Fish or shellfish show no presence of tissue taint **or**

Scientific Monitoring Study	Objectives	Initiation triggers	Termination criteria
Fisheries impact assessment	recreationally important fish species and/or any impacts associated with response activities.	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.	◦ 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.
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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