Plan

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Environment Plan

Artisan-1 Exploration Well Drilling

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
1	19/12/2019	Issued to NOPSEMA for assessment	PW	Xodus	MP
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Review due	Review frequency
Annually from date of acceptance	1 year/s

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

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Acronyms

Terms/acronym	Definition/Expansion
3DTZSS	3D Transitions Zone Seismic Survey
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHTS	Anchor Handling and Tug Supply
ALARP	As Low as Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
ASAP	As Soon As Practicable
Bass Strait CZSF	Bass Strait Central Zone Scallop Fishery
Bbl	Barrel
Beach	Beach Energy Limited
BHA	Bottom Hole Assembly
BIA	Biologically Important Area
BOM	Bureau of Meteorology
BOP	Blow-out Preventer
BWMC	Ballast Water Management Certificate
BWMP	Ballast Water Management Plan
BWTS	Ballast Water Treatment System
CMT	Crisis Management Team
COLREG	Convention on The International Regulations for Preventing Collisions at Sea
CFSR	Climate Forecast System Reanalysis
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DAWR	Commonwealth Department of Agriculture and Water Resources now the Department of Agriculture, Water and the Environment
DELWP	Victorian Department of Environment, Land, Water and Planning
DPIPWE	Tasmanian Department of Primary Industries, Parks, Water and Environment
DJPR	Victorian Department of Jobs, Precincts and Regions
DNP	Commonwealth Director of National Parks
DotEE	Commonwealth Department of the Environment and Energy now the Department of Agriculture, Water and the Environment
DP	Dynamic Positioning

Terms/acronym	Definition/Expansion
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities now the Department of Agriculture, Water and the Environment
DTAC	Device tracking and control
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMBA	Environment That May Be Affected
EMPCA	Environmental Management and Pollution Control Act 1994
EMT	Emergency Management Team
ENSO	El Niño – Southern Oscillation
EP	Environment Plan
EPA	Environmental Protection Authority (Victoria)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPO	Environment Performance Outcome
EPS	Environment Performance Standard
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
ETBF	Eastern Tuna and Billfish Fishery
HFO	Heavy Fuel Oil
HLV	Heavy Lift Vessel
HSE	Health, Safety and Environment
HSEMS	Health, Safety and Environment Management System
Hz	Hertz
IAPP	International Air Pollution Prevention
IBRA	Interim Biogeographic Regionalisation for Australia
IC	Incident Commander
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organisation
IMS	Invasive Marine Species
IOGP	International Association of Oil and Gas Producers
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
Lattice	Lattice Energy Limited
LOC	Loss of Containment
LOWC	Loss of Well Control
LWD	Logging Whilst Drilling

Terms/acronym	Definition/Expansion
MAE	Major Accident Event
MARPOL	International Convention for The Prevention of Pollution from Ships
MC	Measurement Criteria
MDO	Marine Diesel Oil
MDRT	Measure Depth Rotary Table
MNES	Matters of National Environmental Significance
MNP	Marine National Park
MO	Marine Order
MOC	Management of Change
MODIS	Moderate Resolution Imaging Spectroradiometer
MODU	Mobile Offshore Drilling Unit
MP	Marine Park
MT	Metric Tonne
NatPlan	National Plan for Maritime Environmental Emergencies
NEBA	Net Environmental Benefit Analysis
NP	National Park
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NSW	New South Wales
OGP	Otway Gas Plant
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Commonwealth)
Origin	Origin Energy Resources Limited
OSMP	Operational and Scientific Monitoring Plan
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
PHG	Pre-hydrated Gel
PMS	Planned Maintenance System
POLREP	Marine Pollution Report
POWBONS Act	Pollution of Waters by Oil and Noxious Substances Act 1986
PSZ	Petroleum Safety Zone
PTS	Permanent Threshold Shift
RMR	Riserless Mud Recovery
RO	Reverse Osmosis

Terms/acronym	Definition/Expansion
ROC	Residual on Cuttings
ROV	Remotely Operated Underwater Vehicle
SBDF	Synthetic-Based Drilling Fluid
SBTF	Southern Bluefin Tuna Fishery
SCE	Solids Control Equipment
SCCP	Source Control Contingency Plan
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMR	South-East Marine Region
SESSF	Southern and Eastern Scalefish And Shark Fishery
SETFIA	South East Trawl Fishing Industry Association
SIMAP	Spill Impact Mapping Analysis Program
SIV	Seafood Industry Victoria
SMP	Scientific Monitoring Program
SMPEP	Shipboard Marine Pollution Emergency Plan
SMS	Scientific Monitoring Study
SOPEP	Shipboard Oil Pollution Emergency Plan
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SST	Sea surface temperature
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
TVD	Total Vertical Depth
VLSFO	Very Low Sulphur Fuel Oil
VSP	Vertical Seismic Profiling
WBDF	Water-Based Drilling Fluid
WECS	Well Engineering and Construction Management System
WET	Beach Energy Wells Emergency Team
Woodside	Woodside Petroleum Ltd
WOMP	Well Operations Management Plan
XMT	Xmas Tree

1 Overview of the Activity

Beach Energy (Operations) Limited (Beach) proposes to drill a single exploration well (with the option to suspend and develop pending reservoir analysis) in Commonwealth waters of the Otway Basin approximately 32 km off Victoria's south-west coast. The proposed Artisan-1 well location is at a water depth of approximately 71 m.

The operational area for the drilling program has been defined as a 2 km radius around the well whilst the mobile offshore drilling unit (MODU) is moored on location. The 2 km radius encompasses both the outer extent of mooring equipment on the seabed, and the 500 m rig safety exclusion zone.

The drilling activity was scheduled to commence in Q1 or Q2 2020 but has been delayed. The laying of anchors, mooring chains and surface buoys has occurred. Depending on contracting of a suitable MODU, drilling is anticipated to occur within the period from Q3 2020 to the end of 2021. The well is expected to take approximately 35 to 55 days to drill, depending on the final work program and potential operational delays. The Artisan-1 well maybe suspended for future production if commercial quantities of hydrocarbons are discovered. In this eventuality, the well will be suspended in accordance with the Well Operations Management Plan (WOMP) and the wellhead will be left in place to facilitate future operations. Any potential future production drilling of Artisan-1 well will be addressed under a separate Environment Plan (EP).

Drilling and support operations will be conducted on a 24-hour basis for the duration of the program.

Activities included in the scope of this EP are detailed in Section 4.

Activities excluded from the scope of this EP include:

- activities associated with the establishment and operation of a shore base to support the activity which are regulated by the relevant State government.
- vessels transiting to or from the operational area. The vessels are deemed to be operating under the Commonwealth Navigation Act 2012 and not performing a petroleum activity whilst outside the operational area.
- mobilisation of the MODU into Australian Commonwealth waters and Victorian State waters, and associated biosecurity and ballast water management prior to the arrival of the MODU into the operational areas. The MODU is subject to biosecurity control on entering Australian territory (12 nm offshore) in accordance with the Biosecurity Act 2015. Ballast water must be managed in accordance with the Australian Ballast Water Management Requirements Rev 8. Both biosecurity and ballast water management are administered by the Commonwealth Department of Agriculture. If the MODU is mobilised into Victorian waters prior to the commencement of drilling activities in Commonwealth waters biosecurity will be administered by Victorian State regulators and the Victorian Port. Biosecurity and ballast water management of the MODU prior to the movement of the MODU into the operational area is managed directly by and remains the responsibility of the Drilling Contractor.

1.1 Environment Plan Summary

This Artisan-1 Exploration Well Drilling Environment Plan (EP) Summary has been prepared from material provided in this EP. The summary consists of the following (Table 1-1) as required by Regulation 11(4)(a) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R).

Table 1-1: EP Summary of material requirements

EP Summary Material Requirement	Relevant Section of EP Containing EP Summary Material
The location of the activity	Section 4.1
A description of the receiving environment	Section 5
A description of the activity	Section 4
Details of the environmental impacts and risks	Section 6 and 7
The control measures for the activity	Section 7.20
The arrangements for ongoing monitoring of the titleholder's environmental performance	Section 8.10, Section 8.20 and Section 8.24
Response arrangements in the oil pollution emergency plan	Refer to Offshore Pollution Emergency Plan (OPEP)
Consultation already undertaken and plans for ongoing consultation	Section 9
Details of the titleholders nominated liaison person for the activity	Section 2.2

2 Introduction

This document has been prepared to meet the requirements of an EP under the OPGGS(E)R. It addresses the activities to be undertaken during the Artisan-1 Exploration Well Drilling Program located in Commonwealth waters of the Otway Basin off the coast of Victoria.

The Artisan-1 Exploration Well Drilling Program will be undertaken within Permit VIC/P43. Figure 2-1: Artisan-1 well proposed location details the proposed location of the Artisan-1 Exploration Well.

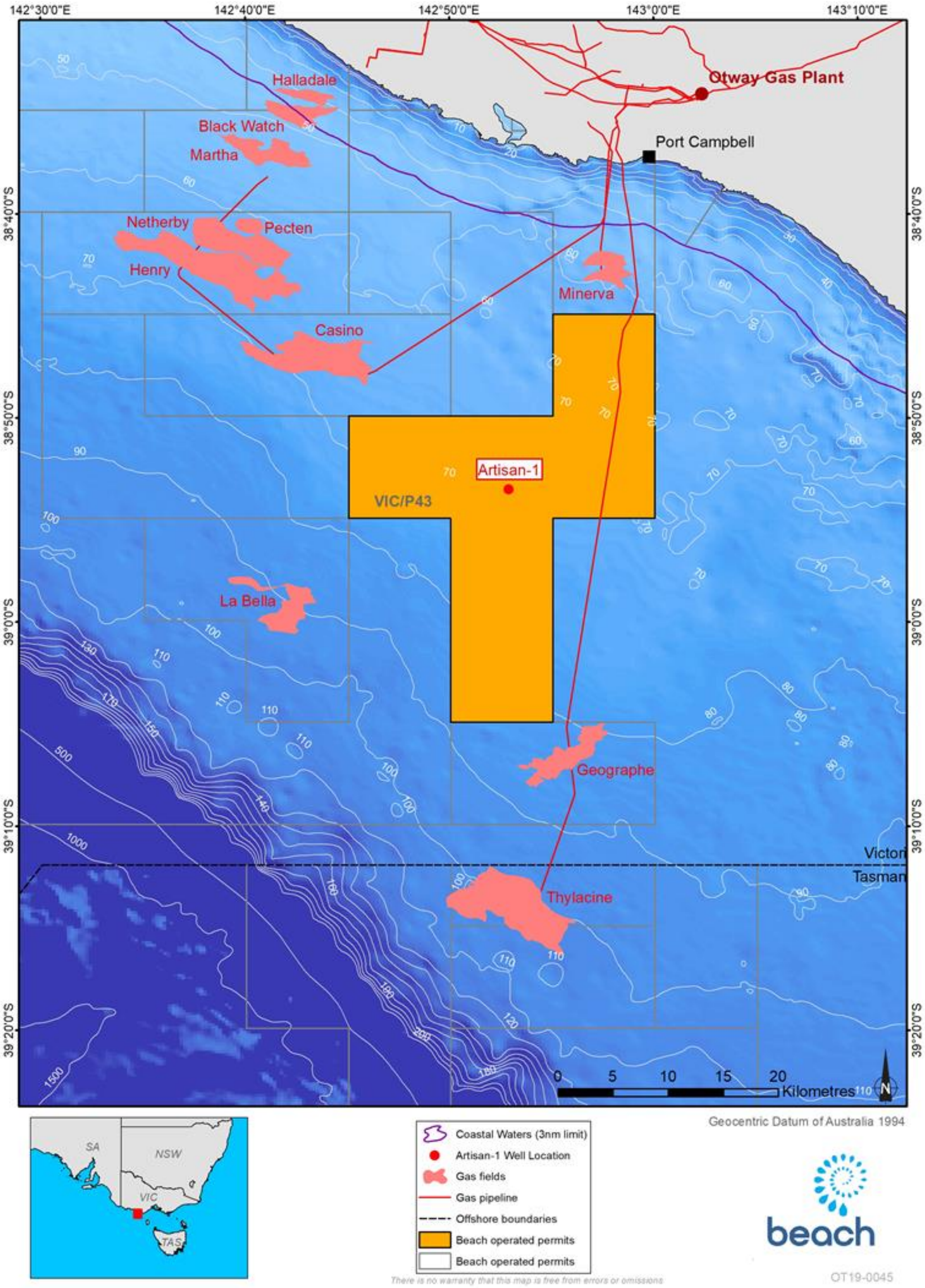


Figure 2-1: Artisan-1 well proposed location

2.1 Background

Beach has several gas producing assets in the Otway Basin. To date, three development phases have been completed to support natural gas supply via the onshore Otway Gas Plant (OGP):

- Phase 1: Otway Gas Plant and Thylacine offshore platform;
- Phase 2: Inlet Gas Compression; and
- Phase 3: Geographe Subsea Development.

To maintain continued economic natural gas production, further phases to develop additional offshore wells are being investigated. One of these is an exploration well in the Artisan Field (Artisan-1) which will form part of the Phase 4 development.

2.2 Titleholder and liaison person details

The operator of permit VIC/P43 is Beach Energy (Operations) Limited. Table 2-1 details the titleholders and the liaison person for the title applicable to the activity.

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

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

In accordance with the Regulation 15(3) of the OPGGS(E)R Beach shall notify the Regulator (National Offshore Petroleum Safety and Environmental Management Authority [NOPSEMA]) of a change to the 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 during the proposed activity.

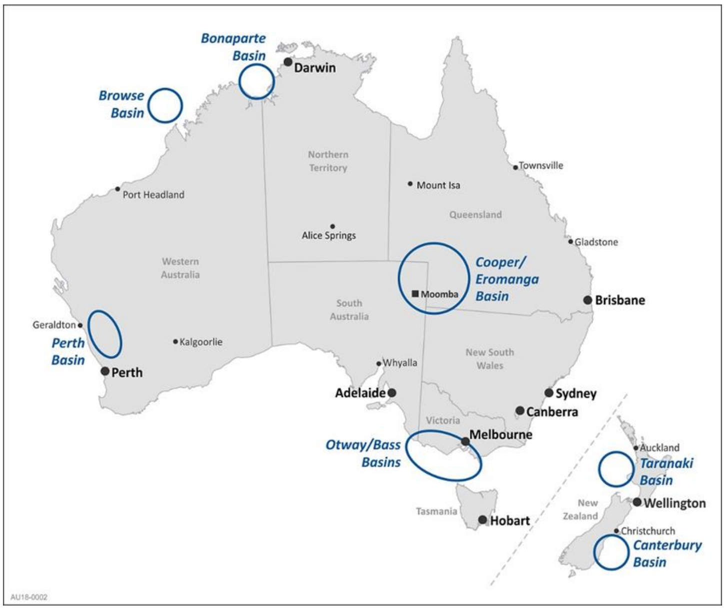


Figure 2-2: Beach operations

Table 2-1: Details of titleholder and liaison person

Petroleum Title	**Details**	
VIC/P43	Titleholder	Beach Energy (Operations) Limited - Operator OGOG (Otway) Pty Ltd
	Business address	Level 8 80 Flinders Street Adelaide South Australia 5000
	Telephone number	(08) 8338 2833
	Fax number	(08) 8338 2336
	Email address	info@beachenergy.com.au
	Australian Company Number	Beach Energy (Operations) Limited (ABN: 66 007 845 338)
Titleholder Liaison Person		
Mr Mika Porter Lead Drilling Engineer	Business address	Level 8 80 Flinders Street Adelaide South Australia 5000
	Telephone number	(08) 8338 2833
	Fax number	(08) 8338 2336
	Email address	info@beachenergy.com.au

3 Applicable Requirements

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

The proposed activity is within Commonwealth waters. Commonwealth legislation (including relevant international conventions) and other requirements relevant to exploration drilling are summarised in Table 3-1.

Although activities under this EP are located entirely in Commonwealth waters, Victorian and Tasmanian legislation relevant to offshore petroleum activities is described in Table 3-2 and Table 3-3 on the basis that a worst-case credible oil spill has the potential to intersect Victorian or Tasmanian waters.

3.1 EPBC Act Requirements

This EP considers the impacts to matters of national environmental significance (MNES) protected under Part 3 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Relevant requirements associated with the EBPC Act, related policies, guidelines, plans of management, recovery plans, threat abatement plans and other relevant advice issued by the Commonwealth of Australia and/or the Department of Agriculture, Water and the Environment (DAWE) are detailed in the applicable sections within Section 5 as part of the description of the existing environment.

Recovery plans, threat abatement plans and species conservation advices applicable to species identified in Section 5 are detailed in Table 3-4.

Table 3-1: Commonwealth environmental legislation relevant to Artisan-1 exploration drilling

Legislation	Scope	Related International Conventions	Administering Authority
Australian Maritime Safety Authority Act 1990	This Act facilitates international cooperation and mutual assistance in preparing and responding to a major oil spill incident and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are effected through AMSA who administers the National Plan for Maritime Environmental Emergencies (NatPlan). **Application to activity**: AMSA is the designated Control Agency for oil spills from vessels in Commonwealth waters. *These arrangements are detailed in the OPEP*.	International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969 Articles 198 and 221 of the United Nations Convention on the Law of the Sea 1982	Australian Maritime Safety Authority (AMSA)
Australian Ballast Water Management Requirements (Department of Agriculture, 2017)	The Australian Ballast Water Management Requirements set out the obligations on vessel operators with regards to the management of ballast water and ballast tank sediment when operating within Australian seas. **Application to activity**: Provides requirements on how vessel operators should manage ballast water when operating within Australian seas to comply with the Biosecurity Act. Section *7.11 details these requirements in relation to the management of ballast water.*	International Convention for the Control and Management of Ships' Ballast Water and Sediments (adopted in principle in 2004 and in force on 8 September 2017)	Department of Agriculture, Water and the Environment (DAWE)
Biosecurity Act 2015 Biosecurity Regulations 2016	This Act replaced the *Quarantine Act 1908* in 2015 and is the primary legislation for the management of the risk of diseases and pests that may cause harm to human, animal or plant health, the environment and the economy. The objects of this Act are to provide for: (a) managing biosecurity risks; human disease; risks related to ballast water; biosecurity emergencies and human biosecurity emergencies;	International Convention for the Control and Management of Ships' Ballast Water and Sediments (adopted in principle in 2004 and in force on 8 September 2017)	DAWE

Legislation	Scope	Related International Conventions	Administering Authority
	(b) to give effect to Australia's international rights and obligations, including under the International Health Regulations, the Sanitary and Phytosanitary Agreement and the Biodiversity Convention. **Application to activity**: The Biosecurity Act and regulations apply to 'Australian territory' which is the airspace over and the coastal seas out to 12 m from the coastline. For the activity the Act regulates vessels entering Australian territory regarding ballast water and hull fouling. *Biosecurity risks associated with the activity are detailed in Section 7.11.*		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	This Act applies to actions that have, will have or are likely to have a significant impact on matters of national environmental or cultural significance. The Act protects matters of national environmental significance (MNES) and provides for a Commonwealth environmental assessment and approval process for actions. There are eight MNES, these being: • World heritage properties; • Ramsar wetlands; • Listed threatened species and communities; • Listed migratory species; • Protection of the environment from nuclear actions; • Marine environment (Commonwealth); • Great Barrier Reef Marine Park; and • Protection of water resources from coal seam gas developments and large coal mining developments. **Application to activity**: Petroleum activities are excluded from within the boundaries of a World Heritage Area (Sub regulation 10A(f)).	1992 Convention on Biological Diversity and 1992 Agenda 21 Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 Agreement between the Government and Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment 1974 Agreement between the Government and Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 Agreement between the Government of Australia and the Government of the Republic of Korea on The Protection of Migratory Birds 2006 Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 (Ramsar)	DAWE

Legislation	Scope	Related International Conventions	Administering Authority
	The activity is not within a World Heritage Area. The EP must describe matters protected under Part 3 of the EPBC Act and assess any impacts and risks to these. *Section 5 describes matters protected under Part 3 of the EPBC Act.* The EP must assess any actual or potential impacts or risks to MNES from the activity. *Section 7 provides an assessment of the impacts and risks from the activity to matters protected under Part 3 of the EPBC Act.*	International Convention for the Regulation of Whaling 1946 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979	
Environment Protection and Biodiversity Conservation Regulations 2000	Part 8 of the regulations provide distances and actions to be taken when interacting with cetaceans. **Application to activity**: The interaction requirements are applicable to the activity in the event that a cetacean is sighted. *Section 7 details how these requirements will be applied.*	-	DAWE
Marine Pest Plan 2018–2023: National Strategic Plan for Marine Pest Biosecurity	Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capabilities to manage the threat of marine pests over the next five years. It represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities and the environment. **Application to activity**: Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species *Section 7.11 details how these requirements will be applied.*		DAWE
National Biofouling Management Guidelines for the Petroleum Production	The guidance document provides recommendations for the management of biofouling risks by the petroleum industry.		DAWE

Legislation	Scope	Related International Conventions	Administering Authority
and Exploration Industry 2009	**Application to activity**: Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species. *Section 7.11 details how these requirements will be applied.*		
National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. **Application to activity**: Applying the recommendations within this document and implementing effective controls can reduce the risk of the vessel collisions with megafauna. *Section 7.12 details the requirements applicable to vessel activities.*		DAWE
Navigation Act 2012	This Act regulates ship-related activities and invokes certain requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) relating to equipment and construction of ships. Several Marine Orders (MO) are enacted under this Act relating to offshore petroleum activities, including: • MO 21: Safety and emergency arrangements. • MO 30: Prevention of collisions. • MO 31: SOLAS and non-SOLAS certification. **Application to activity**: The relevant vessels (according to class) will adhere to the relevant MO with regard to navigation and preventing collisions in Commonwealth waters. *Section 7 details the requirements applicable to vessel activities.*	Certain sections of MARPOL International Convention for the Safety of Life at Sea 1974 COLREG 1972	AMSA
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act) OPGGS(E)R	The Act addresses all licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations extending beyond the three-nautical mile limit. Part 2 of the OPGGS(E)R specifies that an EP must be prepared for any petroleum activity and that activities are undertaken in an	-	NOPSEMA

Legislation	Scope	Related International Conventions	Administering Authority
	ecologically sustainable manner and in accordance with an accepted EP. **Application to activity**: The OPGGS Act provides the regulatory framework for all offshore petroleum exploration and production activities in Commonwealth waters, to ensure that these activities are carried out: • consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act. • so that environmental impacts and risks of the activity are reduced to as low as reasonably practicable (ALARP). • so that environmental impacts and risks of the activity are of an acceptable level. *Demonstration that the activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities are ALARP and acceptable is provided in Section 7.*		
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	This Act regulates Australian regulated vessels with respect to ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. **Application to activity**: All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several MOs are enacted under this Act relating to offshore petroleum activities, including: • MO 91: Marine Pollution Prevention – Oil. • MO 93: Marine Pollution Prevention – Noxious Liquid Substances. • MO 94: Marine Pollution Prevention – Packaged Harmful Substances.	Various parts of MARPOL	AMSA

Legislation	Scope	Related International Conventions	Administering Authority
	• MO 95: Marine Pollution Prevention – Garbage. • MO 96: Marine Pollution Prevention – Sewage. • MO 97: Marine Pollution Prevention – Air Pollution. *Section 7 details the requirements applicable to vessel and MODU activities.*		
Protection of the Sea (Harmful Anti-fouling Systems) Act 2006	Under this Act, it is an offence for a person to engage in negligent conduct that results in a harmful anti-fouling compound being applied to or present on a ship. The Act also provides that Australian ships must hold 'anti-fouling certificates', provided they meet certain criteria. **Application to activity**: All ships involved in offshore petroleum activities in Australian waters are required to abide to the requirements under this Act. The MO 98: Marine Pollution Prevention – Anti-fouling Systems is enacted under this Act. *Section 7 details the requirements applicable to vessel activities.*	International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001	AMSA
Underwater Cultural Heritage Act 2018	Protects the heritage values of shipwrecks, sunken aircraft and relics (older than 75 years) in Australian Territorial waters from the low water mark to the outer edge of the continental shelf (excluding the State's internal waterways). The Act allows for protection through the designation of protection zones. Activities / conduct prohibited within each zone will be specified. **Application to activity**: In the event of removal, damage or interference to shipwrecks, sunken aircraft or relics declared to be historic under the legislation, activity is proposed with declared protection zones, or there is the discovery of shipwrecks or relics. *Section 5.9.1 identifies no known shipwrecks or sunken aircraft in the EMBA.*	Agreement between the Netherlands and Australia concerning old Dutch Shipwrecks 1972	DAWE

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

Legislation	Scope	Application to Activity	Administering Authority
Environment Protection Act 1970 (& various regulations)	This is the key Victorian legislation which controls discharges and emissions (air, water) to the environment within Victoria (including state and territorial waters). It gives the Environment Protection Authority (EPA) powers to licence premises discharges to the marine environment, control marine discharges and to undertake prosecutions. Provides for the maintenance and, where necessary, restoration of appropriate environmental quality.	Oil pollution management in Victorian State waters	Environment Protection Authority Victoria (EPA)
	The State Environment Protection Policy (Waters of Victoria) designates: • spill response responsibilities by Victorian Authorities to be undertaken in the event of spills (DJPR) with EPA enforcement consistent with the *Environment Protection Act 1970* and the *Pollution of Waters by Oil & Noxious Substances Act 1986*. • requires vessels not to discharge to surface waters sewage, oil, garbage, sediment, litter or other wastes which pose an environmental risk to surface water beneficial uses. To protect Victorian State waters from marine pests introduced via domestic ballast water, ballast water management arrangements applying to all ships in State and territorial waters must be observed as per the *Environment Protection (Ships' Ballast Water) Regulations 2006, Waste Management Policy (Ships' Ballast Water)* and the *Protocol for Environmental Management*. High risk domestic ballast water (ballast water which leachates from an Australian port or within the territorial sea of Australia (to 12 nm)), regardless of the source, must not be discharged into Victorian State waters. Ship masters must undertake a ballast water risk assessment on a voyage by voyage basis to assess risk level, provide accurate and comprehensive information to the EPA on the status and risk of ballast water contained on their ships (i.e. domestic/international), and to manage domestic ballast water discharges with EPA written approval.	Discharge of domestic ballast water from emergency response vessels into Victorian State waters must comply with these requirements.	

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

Legislation	Scope	Application to Activity	Administering Authority
Marine Safety Act 2010 (& Regulations 2012)	Act provides for safe marine operations in Victoria, including imposing safety duties on owners, managers and designers of vessels, marine infrastructure and marine safety equipment; marine safety workers, masters and passengers on vessels; regulation and management of vessel use and navigation in Victorian State waters; and enforcement provisions of Police Officers and the Victorian Director of Transport Safety. This Act reflects the requirements of international conventions - *Convention on the International Regulations for Preventing Collisions at Sea* & *International Convention for the Safety of Life at Sea*. The Act also defines marine incidents and the reporting of such incidents to the Victorian Director of Transport Safety.	Applies to vessel masters, owners, crew operating vessels in Victorian State waters.	Maritime Safety Victoria
National Parks Act 1975	Established a number of different types of reserve areas onshore and offshore, including Marine National Parks and Marine Sanctuaries. A lease, licence or permit under the OPGGS Act 2010 that is either wholly or partly over land in a marine national park or marine sanctuary is subject to the *National Parks Act 1975* and activities within these areas require Ministerial consent before activities are carried out.	Applies where there are activities within marine reserve areas.	DELWP
Pollution of Waters by Oil and Noxious Substances Act 1986 (POWBONS) (& Regulations 2002)	The purpose of the *Pollution of Waters by Oils and Noxious Substances Act 1986* (POWBONS) is to protect the sea and other waters from pollution by oil and noxious substances. This Act also implements the MARPOL Convention (the International Convention for the Prevention of Pollution from Ships 1973) in Victorian State waters. Requires mandatory Reporting of marine pollution incidents. Act restricts within Victorian State waters the discharge of treated oily bilge water according to vessel classification (>400 tonnes); discharge of cargo substances or mixtures; prohibition of garbage disposal and packaged harmful substances; restrictions on the discharge of sewage; regulator reporting requirements for incidents; ship construction certificates and survey requirements. Restriction on discharges within Victorian State waters incorporated into EP.	Triggered in the event of a spill impacting or potentially impacting State waters.	Jointly administered by DJPR and EPA

Legislation	Scope	Application to Activity	Administering Authority
Wildlife Act 1975 (& Regulations 2013)	The purpose of this Act is to promote the protection and conservation of wildlife. Prevents wildlife from becoming extinct and prohibits and regulates persons authorised to engage in activities relating to wildlife (including incidents). The *Wildlife (Marine Mammal) Regulations 2009* prescribe minimum distances to whales and seals/seal colonies, restrictions on feeding/touching and restriction of noise within a caution zone of a marine mammal (dolphins (150 m), whales (300 m) and seals (50 m).	Applies where vessels are within State waters responding to a spill event. Prescribed minimum proximity distances to whales, dolphins and seals will be maintained. Triggered if an incident results in the injury or death of whales, dolphins or seals.	DELWP

Table 3-3: Tasmanian Environment Legislation Relevant to potential impacts to State waters and lands

Legislation	Scope	Application to Activity	Administering Authority
Environmental Management and Pollution Control Act 1994 (EMPCA) (& Regulations)	EMPCA is the primary environment protection and pollution control legislation in Tasmania. It is a performance-based style of legislation, with the fundamental basis being the prevention, reduction and remediation of environmental harm. The clear focus of the Act is on preventing environmental harm from pollution and waste. Relevant regulations under the EMPCA include: • Environmental Management and Pollution Control (General) Regulations 2017 • Environmental Management and Pollution Control (Waste Management) Regulations 2010 The EPA Division Compliance Policy provides the Director of the EPA powers of compliance.	Defines the EPA's jurisdiction during a spill event. Prescribes the fee structure to waste events and environmental protection notices. Regulates the management and control of controlled wastes. See OPEP	Department of Primary Industries, Parks, Water and Environment (DPIPWE)
Pollution of Waters by Oil and Noxious Substances Act 1987	Pollution of the sea in Tasmanian State waters may be regulated by general pollution laws such as the EMPCA (see above), but the Pollution of Waters by Oil and Noxious Substance Act 1987 deals specifically with discharges of oil and other pollutants from ships. In accordance with current national arrangements, the Pollution of Waters by Oil and Noxious Substance Act 1987 gives effect in Tasmania to the MARPOL international convention on marine pollution.	Gives effect to MARPOL in Tasmanian waters.	DPIPWE

Table 3-4: Recovery plans, threat abatement plans and species conservation advices relevant to Artisan-1 exploration drilling

Relevant Plan/Advice	***Description***	***Applicable Threats or Management Advice***
Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (Commonwealth of Australia, 2018)	The plans focus on strategic approaches to reduce the impacts of marine debris on vertebrate marine life.	***Marine debris*** Evaluate risk of marine debris (including risk of entanglement and/or ingestion) and, if required, appropriate mitigation measures are implemented.
National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011–2016 (DSEWPaC, 2011a)	The recovery plan is a co-ordinated conservation strategy for albatrosses and giant petrels listed as threatened.	***Marine pollution*** Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. ***Marine debris*** Evaluate risk of marine debris (including risk of entanglement and/or ingestion) and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for *Pterodroma mollis* (soft-plumaged petrel) (TSSC, 2015c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the soft-plumaged petrel.	None identified.
Approved Conservation Advice for *Sternula nereis nereis* (Australian fairy tern) (DSEWPC, 2011c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the fairy tern.	***Marine pollution*** Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented.
Draft National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (Commonwealth of Australia, 2019b)	Draft recovery plan for actions so species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria.	Habitat degradation and loss of breeding habitat Pollution
Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015e)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the eastern curlew.	Habitat degradation/ loss (oil pollution)

Relevant Plan/Advice	***Description***	***Applicable Threats or Management Advice***
Conservation Advice *Limosa lapponica menzbieri* (bar-tailed godwit (northern Siberian)) (TSSC, 2016)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the bar-tailed godwit (northern Siberian).	Habitat degradation/ loss (oil pollution)
Conservation Advice *Limosa lapponica baueri* (bar-tailed godwit (western Alaskan)) (TSSC, 2016b)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the bar-tailed godwit (western Alaskan).	Habitat degradation/ loss
Approved Conservation Advice for *Pachyptila subantarctica* (fairy prion (southern)) (TSSC, 2015d)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the fairy prion (southern).	None identified.
Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (DSEWPaC, 2013c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Australian painted snipe.	None identified.
Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the greater sand plover.	Habitat degradation/ loss (oil pollution)
Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the curlew sandpiper.	Habitat degradation/ loss (oil pollution)
Approved Conservation Advice for *Calidris canutus* (red knot) (TSSC, 2016d)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the red knot.	***Marine pollution*** Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented.

Relevant Plan/Advice	***Description***	***Applicable Threats or Management Advice***
Approved Conservation Advice for *Botaurus poiciloptilus* (Australasian bittern) (TSSC, 2019)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Australasian bittern.	None identified.
National Recovery Plan for *Pterodroma leucoptera leucoptera* (Gould's petrel) (DEC NSW, 2006)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Gould's petrel.	None identified.
National Recovery Plan for the *Neophema chrysogaster* (orange-bellied parrot) (DELWP, 2016a)	The recovery plan is a co-ordinated conservation strategy for the orange-bellied parrot.	Illuminated boats and structures: evaluate risk of lighting on vessels and offshore structures.
National Recovery Plan for the *Lathamus discolour* (swift parrot) (Saunders and Tzaros, 2011)	The recovery plan is a co-ordinated conservation strategy for the swift parrot.	None identified.
Approved Conservation Advice for the *Halobaena caerulea* (blue petrel) (TSSC, 2015e)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the blue petrel	None identified.
Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015b)	The long-term recovery plan objective for migratory shorebirds is to minimise anthropogenic threats to allow for the conservation status of these bird species.	Habitat degradation/ modification (oil pollution)
National Recovery Plan for the *Prototroctes maraena* (Australian grayling) (Backhouse et al., 2008)	The recovery plan is a co-ordinated conservation strategy for the Australian grayling.	Poor water quality and siltation: Typically, from onshore sources. Impact of introduced fish: Typically, from onshore sources.
Recovery Plan for the *Carcharodon carcharias* (white shark) (DSEWPaC, 2013a)	The recovery plan is a co-ordinated conservation strategy for the white shark.	None identified.

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
Approved Conservation Advice for the *Rhicodon typus* (whale shark) (TSSC, 2015b)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the whale shark	Vessel strike.
Recovery Plan for Marine Turtles in Australia, 2017-2027 (Commonwealth of Australia, 2017b)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles	• chemical and terrestrial discharge. • marine debris. • light pollution. • habitat modification. • vessel strike. • noise interference. • vessel disturbance.
Approved Conservation Advice for *Dermochelys coriacea* (leatherback turtle) (DEWHA, 2008)	See above for the recovery plan for marine turtles in Australia, 2017-2027.	
Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b)	The long-term recovery plan objective for blue whales is to minimise anthropogenic threats to allow for their conservation status to improve	***Noise interference*** Evaluate risk of noise impacts and, if required, appropriate mitigation measures are implemented. ***Vessel disturbance*** Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015g)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the sei whale.	***Noise interference*** Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. ***Vessel disturbance*** Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (TSSC, 2015a)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the humpback whale.	***Noise interference*** Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. ***Vessel disturbance***

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
		Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.
Conservation Management Plan for the Southern Right Whale 2011-2021 (DSEWPaC, 2012a)	Conservation management plan provides threat abatement activities that can be undertaken to ensure the conservation of the southern right whale.	***Noise interference*** Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. ***Vessel disturbance*** Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015f)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the fin whale.	***Noise interference*** Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. ***Vessel disturbance*** Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.
Conservation Listing Advice for the *Neophoca cinerea* (Australian sea lion) (TSSC, 2010)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the Australian sea lion.	Known threats to this species include habitat and prey availability, competition with other seals, fisheries bycatch (bottom-set gillnet, rock lobster), entanglement in marine debris, disturbance, harassment and displacement, predation and direct killing. Potential threats to this species include habitat degradation, oil spills, pollution, toxins and climate change
Recovery Plan for the *Neophoca cinerea* (Australian sea lion) (DSEWPaC, 2013).	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure its long-term viability in nature and the parties that will undertake those actions.	***Habitat degradation*** No explicit relevant management actions ***Vessel strike*** Collect data on direct killings and confirmed vessel strikes ***Pollution (oil spills, toxins)*** implement jurisdictional oil spill response strategies as required ***Climate change*** No explicit relevant management actions

3.2 Commonwealth guidance material

This EP has been prepared considering the following regulatory guidance:

- AMSA Technical guidelines for preparing contingency plans for marine and coastal facilities (2015)
- AMSA National Plan for Maritime Environmental Emergencies (the NatPlan)
- DAWR Offshore Installations - Biosecurity Guide (2019)
- DSEWPaC Policy Statement: 'Indirect consequences' of an action: Section 527E of the EPBC Act (2013)
- NOPSEMA Guidance note: Environment plan content requirements – Rev 4 (GN1344) (2019)
- NOPSEMA Guidance note: Petroleum activities and Australian marine parks – Rev 0 (GN1785) (2018)
- NOPSEMA Guidance note: Oil pollution risk management – Rev 2 (GN1488) (2018)
- NOPSEMA Guidance note: Notification and reporting of environmental incidents – Rev 4 (GN0926) (2014)
- NOPSEMA Guidance note: ALARP – Rev6 (GN0166) (2015)
- NOPSEMA Policy: Environment plan assessment - Rev 7 (PL1347) (2019)
- NOPSEMA Guideline: Environment plan decision making – Rev 6 (GL1721) (2019)
- NOPSEMA Guideline: Environment plan summaries – Rev 2 (GL1566) (2019)
- NOPSEMA Guideline: Making submissions to NOPSEMA – Rev 17 (GL0255) (2019)
- NOPSEMA Information paper: Operational and scientific monitoring programs – Rev2 (IP1349) (2016)
- NOSPEMA Information paper: Reducing marine pest biosecurity risks through good practice biofouling management – Rev 1 (IP1899) (2020)
- NOPSEMA Bulletin #1: Oil Spill Modelling – Rev 0 (A652993) (2019)
- NOPSEMA Bulletin #2: Clarifying Statutory Requirements and Good Practice Consultation – Rev 0 (A696998) (2019)

3.3 Industry codes of practice and guideline material

This EP has been prepared considering the following petroleum industry codes of practice and guidance material:

- IFC Environmental, Health, and Safety Guidelines for Offshore oil and Gas Development (2015). These guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) and contain the performance levels and measures that are generally considered to be reasonably achievable, depending on the impacts and risks associated with the activity.
- Australian Maritime Safety Authority (AMSA) technical guidelines for preparing contingency plans for marine and coastal facilities (Commonwealth of Australia, January 2015).
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Oil Spill Monitoring Handbook (2016).

- Department of Agriculture Antifouling and in-water cleaning guidelines (2015).
- Australian Standard AS ISO 31000:2018 Risk Management and Handbook 203:2012 Managing Environment-related Risk.
- Department of Transport (DoT) Marine Pollution Response Arrangements in Victoria – An Industry Perspective, Sean Moran, Security and Emergency Management Division, Department of Transport (Victoria) (2012).
- Victorian Department of Transport, Planning and Local Infrastructure Advisory Note on Offshore Petroleum Industry Oil Spill Contingency Planning Consultation (2013).
- IOGP Report 254: Environmental Management in Oil and Gas Exploration and Production (2008).
- IOGP Report 594: Source Control Emergency Response Planning Guide for Subsea Wells (2019).
- Society of Petroleum Engineers (SPE) Technical Report: Calculation of Worst-Case Discharge (WCD) (2015).
- IMO Guidelines for the control and management of a ships' biofouling to minimise the transfer of invasive aquatic species (2011).

4 Description of the Activity

4.1 Activity location

This EP provides for a single exploration well (with possible side-track) in Commonwealth waters of the Otway Basin approximately 32 km off Victoria's south-west coast. The Otway Basin is an area where petroleum exploration and production activities are well established (Figure 2-2: Beach operations).

The proposed well location is at a water depth of approximately 71 m. Indicative coordinates for the proposed well is presented in Table 4-1.

Table 4-1: Artisan-1 well indicative location

Well name	Well type	Latitude	Longitude	Petroleum title	Water depth (m)	Distance from Port Campbell
Artisan-1*	Exploration	38° 53.490' S	142° 52.948'	VIC/P43	~71 m	32 km

Coordinates are provided as GDA94 UTM54S.

** The final location for Artisan-1 may be subject to change, but is expected to be within 500 m of these coordinates*

4.2 Operational area

The operational area has been defined as the area within which routine drilling operations occur at the well site. For this drilling activity, the operational area is a 2 km radius around the well whilst the MODU is moored on location. This radius encompasses both the outer extent of mooring equipment on the seabed and the 500 m rig safety exclusion zone around the MODU.

4.3 Activity timing

The drilling activity is scheduled to commence between Q3 2020 and the end of 2021 with drilling expected to take approximately 35 to 55 days, depending on the final work program and potential operational delays. The Artisan-1 well may be suspended for future production if the well intersects a commercial hydrocarbon column. In the event of the well being suspended, the wellhead will remain in place and may be used to facilitate future production well operations. This future use would be subject to a separate Environment Plan (EP).

Drilling and support operations will be conducted on a 24-hour basis for the duration of the program.

4.4 Field characteristics

The Turonian Waarre Formation is the source of hydrocarbons targeted for Artisan-1. Artisan-1 is an exploration well, therefore, exact reservoir data is unavailable. The producing formations in the nearby Thylacine reservoir properties are considered to be a suitable analogue for Artisan-1. The expected gas condensate ratio (GCR) of the formation is 81,727 scf/bbl (average). The reservoir properties for Thylacine are provided in Table 4-2 and condensate boiling point ranges are provided in Table 4-3.

Table 4-2: Artisan-1 target reservoir physical characteristics (based on a Thylacine analogue)

Parameter	Thylacine Condensate
Density (kg/m^3)	805 at 15°C
API	44.3
Dynamic viscosity (cP)	0.875 at 20°C
Pour point (°C)	-50
Oil category	Group I
Oil persistence classification	Non-persistent oil

Table 4-3: Condensate boiling point ranges

Parameter	Volatiles (%)	Semi-volatiles (%)	Low-volatiles (%)	Residual (%)
Boiling point (°C)	<180	180-265	265-380	>380
Thylacine Condensate	64.0	19.0	16.0	1
	⇦	Non-Persistent	⇨	⇦ Persistent ⇨

4.5 Activities that have the potential to impact the environment

This section outlines the planned activities covered within the scope of this EP which have the potential to result in environmental aspects, leading to impacts to receptors. The activities included in this EP are:

- drilling and completion activities including MODU and any pre-lay anchoring operations.
- routine support operations:
  - vessel operations;
  - helicopter operations; and
  - ROV operations.
- emergency response activities.

4.5.1 Well design and drilling methodology

An indicative overview of the drilling design and process is described in this section. This process is subject to change, depending on individual well design requirements and the final location of the well. Well schematics are provided in the Well Operations Management Plan (WOMP) submitted to NOPSEMA for assessment prior to drilling.

The top hole well sections (conductor and surface hole) will be drilled without a riser, which is standard practice. The cuttings (rock chips) and drilling fluids from this section will be discharged to sea. A riser and blow-out preventer (BOP) will be installed to facilitate the drilling of the deeper well sections once the surface casing is cemented in place. Once the riser and BOP are installed, drilling fluids and cuttings will be returned to the MODU via the marine riser where the drilling fluids will be separated using solids control equipment. The solids control equipment comprises of shale shakers that remove coarse cuttings from the drilling fluids. After processing by the shale shakers, the recovered fluids, that have been separated from the cuttings, may be directed to centrifuges, which are used to remove the finer solids. The cuttings are usually discharged below the water line and the reconditioned fluids are recirculated into the fluid system. Where synthetic-based drilling fluids (SBDF) are used, the fluids may be further processed using an additional stage of cuttings/fluid separation during which the cuttings are processed through a cuttings dryer system.

Table 4-4 provides a summary of the indicative well design and drilling fluids.

4.5.1.1 Blow-out preventer installation and function testing

A BOP is installed onto the wellhead after completion of the top-hole sections. A BOP consists of a series of hydraulically operated valves and sealing mechanisms (annular preventers and ram preventers) that are normally open to allow the drill fluid to circulate up the marine riser to the MODU during drilling. The BOP is used to close in the well in the event of an influx. The MODU's high-pressure circulating system would be used in this event, after closing of the BOP, to remove the influx from the well and regain hydrostatic overbalance. The annular and ram preventers are used to shut in around various tubulars in the well, while the blind shear rams are designed to shear the pipe and seal the well.

Once the BOP is installed, regular function and pressure tests are undertaken. Function tests are generally undertaken every 7 days, and pressure tests on a 21-day basis, in accordance with industry standards and the Drilling Contractor's maintenance system. Function testing is undertaken by activating the hydraulic control system aboard the MODU to confirm functionality of the BOP systems, whilst a pressure test is undertaken to verify seals on the BOP stack.

The BOP control system discharges control fluid into the sea upon operation. A full function test to close and open all ram and annular preventers discharges approximately 2,200 L of diluted control fluid. The control fluid used for function testing is a water-soluble product and is diluted with potable water to 1 to 3% concentration for use. Likewise, water-based products are used for pressure testing. The fluids are fully biodegradable and will readily disperse after discharge from the BOP.

Greater detail on the performance standards for the BOP system, inclusive of design, functionality and preventative maintenance, is provided in a NOPSEMA-accepted Vessel Safety Case.

4.5.1.2 Drill fluids and cuttings handling and disposal

Drilling fluids used during the program will be either water-based (WBDF), synthetic-based (SBDF) or brines. Drilling fluid performs several functions including; cooling and lubrication of the drill bit; transportation of drill cuttings to the surface; and maintaining hydrostatic pressure in excess of formation pressure, thus preventing the influx of hydrocarbons from the formation into the wellbore, this is the primary well control barrier.

Drilling fluid, bulk dry products, base oil, brine and drill water are transferred to the MODU from supply vessels and stored in tanks and pits. Dry and liquid additives are mixed into the fluid system from sacks or containers.

A summary of the drilling fluids and cuttings discharges are described in Table 4-4.

Table 4-4: Summary of well design and drilling methodology

Well	Hole size	Conductor / casing / liner size	Approx. MDRT (m)*	Fluid type	Approx. cuttings volume (m^3)	Fluid discharge location	Cuttings discharge location
Artisan-1	42"	36"	~161 mMDRT	Sea water & pre-hydrated gel (PHG) sweeps	59	Seabed	Seabed
	17-1/2"	13-3/8"	~650 mMDRT	Sea water & PHG sweeps	76	Seabed	Seabed
	12-1/4"	9-5/8"	~1900 mMDRT	SBDF	96	No whole fluid discharge	Surface – with residual SBDF
	8-1/2"	7"	~2,384 mMDRT	SBDF	18	No whole fluid discharge	Surface – with residual SBDF

* MDRT – measure depth rotary table.

4.5.1.3 Cementing operations

Bulk dry cement is transported to the MODU via supply vessels and transferred to dry bulk storage tanks. During the transfer process, the holding tanks are vented to atmosphere, resulting in small amounts of dry cement being discharged from venting pipes located under the MODU.

Prior to the commencement of cementing operations, the cementing unit is tested resulting in a discharge of between 2.4 m^3 (15 bbl) to 8 m^3 (50 bbl) of cement slurry to sea.

After a string of casing or liner has been installed into the well, a cementing spacer is pumped to flush drilling fluids and filter cake from the well to allow a good cement bond to be formed with the formation. During riserless drilling, the spacer is displaced by the cement slurry and discharged directly to the seabed at the mudline. Once the riser is installed, the pre-flush volumes are such that the spacer will remain downhole or very minor volumes may be returned to the MODU and discharged to sea.

Cement slurry is pumped down the inside of the landing string and then casing (or liner). A displacement fluid is then pumped into the casing with a wiper plug to displace the cement out of the bottom of the casing and up into the annular space between the pipe and the borehole wall. Cement volumes are such that for the 36" casing and the 20 x 13-3/8" casing approximately 15 m^3 (94 bbl) of cement will be discharged to seabed per well. For all other casing and liner cementations the cement will predominantly remain downhole. In the case of a liner cement job, some excess cement will be circulated back to surface and discharged into the sea. When the wiper plug is pumped and reaches the bottom of the casing string it stops and allows the casing to be pressure tested.

If mixed batches of cement spoil within the cementing unit, or there is a problem during the cementing operation, cement slurry will be either flushed from the cement unit or circulated out of the well and discharged to sea. A discharged batch of cement slurry may be up to 22 m^3 (140 bbl).

Upon completion of each cementing activity, the cementing head and blending tanks are cleaned which results in a release of cement contaminated water to the ocean. While this volume may vary, it is typically in the order of <1 m^3 (<6 bbl) per cement job.

4.5.1.4 Formation evaluation

During drilling, the formation is evaluated to determine the presence and quantity of hydrocarbon within the target reservoir. This information is gathered real-time from Logging Whilst Drilling (LWD) techniques and mud logging.

Sonic logs are considered part of the primary formation evaluation objective for the Artisan-1 well. The sonic tool is a completely self-contained down-hole tool. There are no airguns or any other noise sources on surface, and there will be no noise transmitted to the surface. The tool is run as part of a standard LWD (or wireline) suite and the data is transmitted to surface in the same way as the data from all the other LWD tools using mud pulse technology.

Additional down-hole logging sources may include the deployment of resistivity tools and sensors or low-level radioactive sources (such as density-neutron Am-Be & Gamma-Ray Cesium-137). These sources may be required to acquire additional information that cannot be gathered during primary evaluation. These low-level radioactive sources are stored in lockers aboard the MODU and deployed directly down hole with no exposure to the marine environment. Formation pressure and downhole sampling formation evaluation tools (LWD or wireline) may also be run to fully evaluate the reservoir.

Vertical Seismic Profiling (VSP) or check-shot surveys are not proposed to be undertaken as part of this activity.

4.5.1.5 Well suspension

As a contingency to the drilling activity, after completion of drilling operations and before well completion (covered under a separate EP) the well may be suspended (with wellhead in place) in accordance with a NOPSEMA-accepted WOMP. To suspend the well, cement plugs and/or a retrievable suspension packer may be installed within the well. The cement plugs and/or suspension packer provides a barrier, isolating the formation and ensuring well integrity is maintained while the well is temporarily suspended.

Following the suspension of the well with appropriate barriers, a subsea tree cap will be installed to protect the tree connector from damage and marine growth. To inhibit marine growth or corrosion, a biocide and corrosion inhibitor may either be injected or placed within the tree cap. The tree cap can hold approximately 210 L of dilute corrosion / biocide mixture. Typically, the corrosion / biocide mixture is at a ratio of approximately 3 L corrosion inhibitor, 0.25 L biocide, and 207 L water. At this stage, there is no release to the environment; however, when the tree cap is removed, the fluid will be discharged to the marine environment.

4.5.1.6 Plug and abandonment

Depending on the outcome of the formation evaluation, should the Artisan-1 well not be considered viable for future production, the well shall be permanently plugged and abandoned in alignment with Section 572 of the OPGGS Act. Plug and abandonment procedures are designed to permanently isolate the well and mitigate the risk of a potential release of wellbore fluids to the marine environment.

Plug and abandonment operations involve setting a series of permanent cement and mechanical plugs within the wellbore, including plugs above and between any hydrocarbon bearing intervals identified for isolation, at appropriate barrier depths in the well and at the surface. These plugs are tested to confirm their integrity.

Following plug and abandonment operations and confirmation of the permanent barriers, the wellhead is cut with the use of a mechanical cutting tool and removed below the mudline (~1.5 m) leaving no remaining well infrastructure on the seabed. The cutting process produces metal shavings (swarf), some of which remain on the seabed.

Plug and abandonment operations will be conducted in accordance with a NOPSEMA-accepted WOMP.

If the wellhead cannot be removed whilst the MODU is on location, Beach will develop a plan to remove the wellhead at a later date.

4.5.2 MODU details and layout

The Artisan-1 well is proposed to be drilled by a semi-submersible MODU. Whilst the specific MODU is yet to be confirmed, the details and layout of the Diamond Offshore Ocean Onyx, have been used to inform relevant aspects of the environmental impact and risk assessment (Section 7) of this EP, as either this MODU or a MODU with similar capabilities, design and capacities may be used.

Indicative MODU dimensions (based on the Ocean Onyx) are provided in Table 4-5. Generally, a MODU of this capacity operates with approximately 140 persons on board (POB). Indicative storage capacities as summarised in Table 4-6. Routine operational discharges from the MODU within the operational area at full POB are detailed in Table 4-7.

Table 4-5: Indicative MODU dimensions

Dimension	Value
Overall	
Length	111 m (363 ft)
Width	105 m (345 ft)
Height	97.7 m (321 ft)
Draft and Displacement	
Drilling draft (approx.)	22.7 m (74.5 ft)
Drilling displacement (approx.)	49,453 t
Transit draft (approx.)	12.6 m (41.5 ft)
Transit displacement (approx.)	37,866 t

Table 4-6: Indicative MODU storage capacities

Tank	Capacity
Ballast water	24,445 m^3
Diesel oil	1,097 m^3
Heli fuel	5 m^3
Potable water	475 m^3
Drill water	1,824 m^3
Brine	962 m^3
Base oil	524 m^3
Liquid mud	1,345 m^3
Cement	179 m^3
Barite / bentonite	213 m^3
Sewage	25.2 m^3
Saltwater	21.8 m^3
Bilge, drain and skimmer tanks	43.8 m^3
Sack storage	4,000 sacks

4.5.2.1 MODU positioning and mooring

The MODU will be towed to location and moored prior to commencing activities. Eight anchors with associated mooring chains and surface buoys have been positioned (pre-laid) and will remain insitu until drilling is complete. The anchors have been placed at a distance of ~ 1,300 m from the Artisan-1 well location.

Once on location the MODU will be moored with the 8 anchors which each weigh 29 MT and have an individual footprint of approximately 30 m^2 to 60 m^2. A mooring analysis was undertaken to determine specific mooring requirements for the well location. The mooring analysis incorporated the results from the geophysical and geotechnical survey obtained beforehand. Once the MODU is at the well location the anchors are attached to the MODU by a chain, chain / wire or chain / wire / fibre system.

As shown in Figure 4-1 each pre-laid anchor consist of:

- anchor covering an area of approximately 60 m^2
- anchor chain including swivels and shackles. The anchor chain consists of 82.55 – 84 mm links and has a chain weight of ~ 155 kg/m. 1,000 m of chain has been laid with ~ 80 m of free chain in a water depth of ~70 m. This equates to ¬266 m^2 footprint based on the chain is ¬ 290 mm wide.
- surface buoy (7.6 m x 2.34 m x 2.34 m) with a navigation light and device tracking and control (DTAC) transmitter enclosed inside the buoy.

Figure 4-2 shows the prelaid anchor and buoy locations. The buoys are located between 189 m to 1,066 m apart which with ~80 of free chain will ensure they will not entangle.

The total footprint for each anchor and chain is up to 326 m^2.

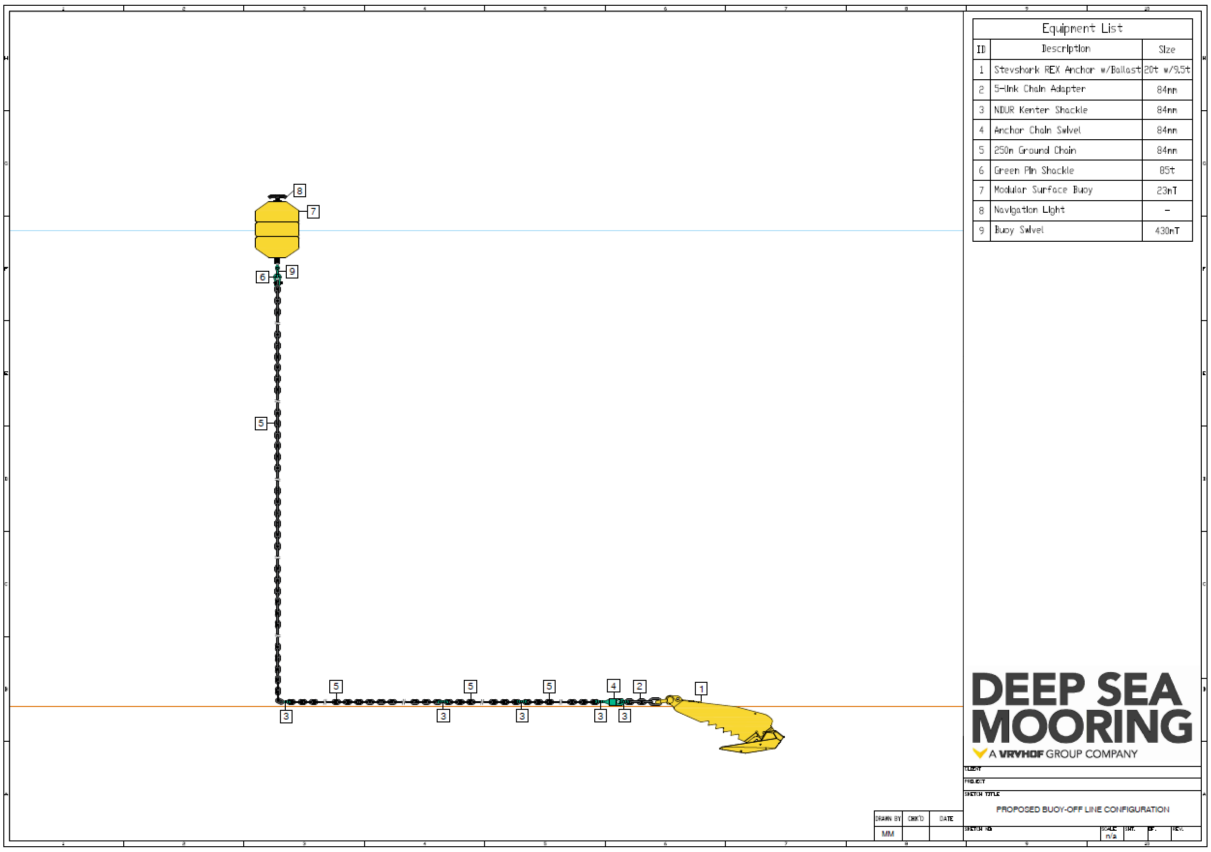


Figure 4-1: Prelaid anchor set up

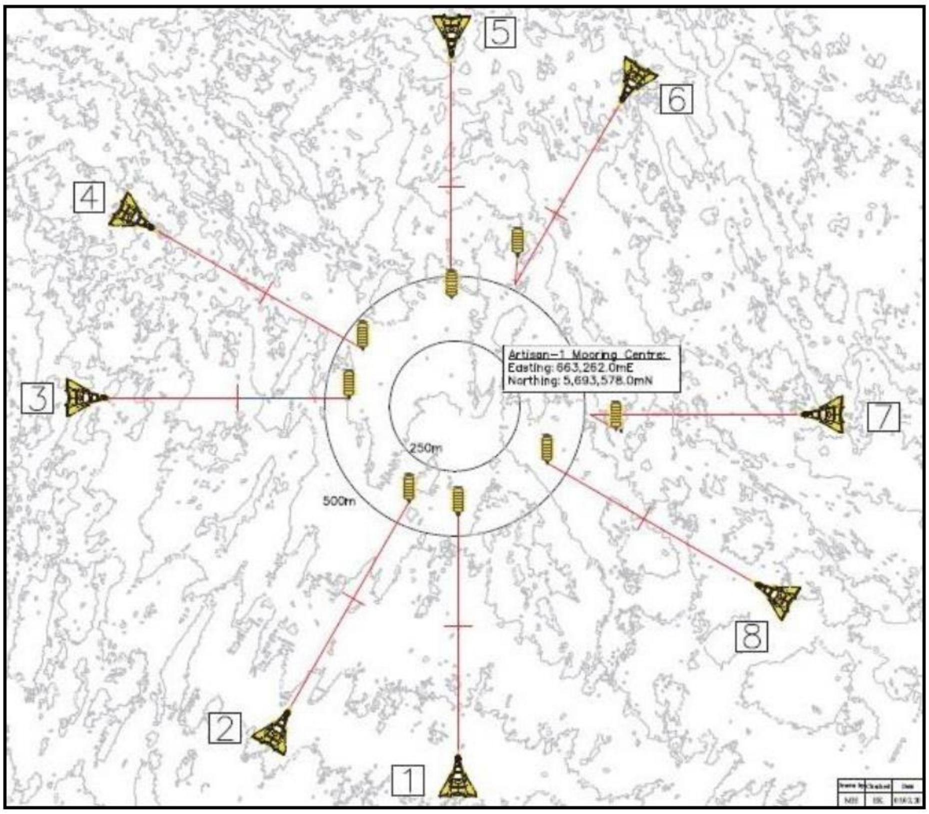


Figure 4-2: Artisan-1 prelaid anchor and buoy locations

4.5.2.2 Power generation system

The MODU engine room is equipped with a number of diesel engines coupled to generators. Additionally, the MODU is fitted with emergency diesel engine and generator auxiliary system, including batteries, transformers and switchboards.

4.5.2.3 Fuel

The MODU has two primary diesel oil tanks, each located in the inboard pontoons. These tanks are generally filled by supply vessels through the bunkering hoses.

4.5.2.4 Saltwater distribution and cooling system

The primary purpose of the saltwater distribution and cooling system is to provide saltwater for the reverse osmosis (RO) units, the fire water system, the main engine cooling system heat exchanger, the anchor chain washing system, the draw works brake cooling unit heat exchanger and various flushing and deck wash connection points throughout the facility.

4.5.2.5 Freshwater generation, distribution and cooling system

The freshwater generation system provides freshwater to the potable water, drill water, engine jacket water, anchor winch and draw works brake cooling system The RO freshwater generators use seawater to generate freshwater, and this sea water is supplied with the saltwater from a RO submersible pump. Brine is discharged from the RO system to the sea.

4.5.2.6 Drainage, effluent and waste systems

The drainage, effluent systems and associated environmental pollution control systems on the facility include:

- non-contaminated bilge sumps, deck drains, headers and oily water tanks and separators.
- contaminated drains, oily water tanks and solids separators.
- helideck drainage and containment system.
- sewage and greywater drainage and sewage treatment plant.
- domestic waste segregation and disposal.
- galley waste disposal including macerator.
- equipment oil drainage, bunding and waste oil tanks.
- cutting processing equipment (see solids control equipment).

4.5.2.7 Solids control equipment

Solids control equipment (SCE) will be used when drilling to separate the solids in the drilling fluids that are crushed by the drill bits and carried out of the well surface. SCE aboard the facility includes:

- shale shakers.
- centrifuging systems.

- cuttings dryer.

4.5.3 Routine support operations

4.5.3.1 Vessel operations

Vessel operations include:

- MODU mobilisation and positioning.
- deployment and retrieval of mooring equipment.
- standby support to monitor and maintain the 500 m rig safety exclusion zone from errant vessels.
- transfer of goods and equipment to and from the MODU.
- deployment of survey equipment.

The MODU will be supported by up to three support vessels with one vessel on standby within the operational area (outside the 500 m rig safety exclusion zone) at any given time and the other two vessels outside the operational area transporting cargo between port and the MODU. Vessels only enter the 500 m rig safety exclusion zone under instruction from the MODU when transferring cargo to the MODU or supporting specific operations. Support vessels generally have approximately 12 to 15 persons on board (POB) at any given time. Routine operational discharges from a single vessel within the operational area at full POB are detailed in Table 4-7.

Support vessels maintain station-keeping via dynamic positioning (DP) during the drilling activity therefore no anchoring is required.

Table 4-7: Routine Operational Discharges within Operational Area

Discharge Type	Quantity MODU (approx.)	Quantity per vessel (approx.)
Putrescible waste	280 kg / day (1-2 kg pp/day)	30 kg / day (1-2 kg pp/day)
Sewage & Grey water	63 m^3 / day (0.45 m^3 pp/day)	7 m^3 / day (0.45 m^3 pp/day)
Cooling Water	4,800 m^3/d combined (MODU + single vessel)	
Atmospheric emissions (e-CO_2)	42 ktCO_2e/month combined (MODU + single vessel)	
RO Brine	168 m^3/day combined (MODU + single vessel)	

4.5.3.2 Helicopter operations

Helicopters are the primary form of transport for personnel to and from the MODU but may also be used during emergency situations, including operational and scientific monitoring in the event of a hydrocarbon spill. Helicopters may service the MODU up to 7 times per week for the duration of the program, generally operating in daylight hours.

Helicopter operations within the operational area are limited to landing and take-off directly to and from the MODU helideck.

Offshore refuelling of the helicopters whilst onboard the MODU is not planned, however, may be undertaken if required.

4.5.3.3 ROV operations

Underwater remotely operated vehicles (ROVs) shall be deployed and controlled from either the MODU or support vessel to undertake:

- pre and post-activity site surveys.
- equipment deployment, monitoring and retrieval.
- tool deployment and operation.
- BOP activation under emergency conditions.

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

The ROVs will be moored on the deck of the vessels and / or MODU and are unlikely to be temporarily parked on the seabed during the program.

5 Description of the Environment

The physical, biological and socio-economic environment that may be affected (EMBA) and any values and sensitivities are described in this section.

5.1 Environment that may be affected

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

Table 5-1 details the EMBAs associated with this drilling activity that are used to describe the environmental context relevant to the activity and to support the impact and risk assessments.

Table 5-1: Description of EMBA Zones

EMBA Zones	***Description***
Operational Area	The operational area is a 2 km radius around the Artisan-1 well whilst the anchors are insitu and the MODU is moored on location. This encompasses both the outer extent of mooring equipment on the seabed and the 500 m rig safety exclusion zone around the MODU. The EPBC Protected Matters Report for the operational area is in Appendix A.2.
Spill EMBA	The boundary of the spill EMBA was defined using the combined results of 200 separate hypothetical spill events for each worst-case scenario (100 summer release scenarios and 100 winter release scenarios) for a diesel and a condensate spill based on the low (instantaneous) in-water exposure thresholds as defined in Table 7-10. Figure 7-18 and Figure 7-19 show these areas which were used to define the offshore extent of the spill EMBA. The onshore extent of the EMBA was defined as all coastal areas within the offshore spatial extent (i.e. not based on shoreline contact from worst-case spill modelling). The spill EMBA is highly conservative and does not represent the actual area that may be affected by a single worst-case spill event. The spill EMBA extends between approximately Marlo (VIC) in the east, Beachport (SA) in the west and King Island to the south (Figure 5-1). The spill EMBA Protected Matter Report is in Appendix A.1.
Light and Noise Behaviour EMBA	The light EMBA is the area that may be affected by light. It has a spatial extent of 20 km radius around the Artisan-1 well whilst the MODU is moored on location. The noise behaviour EMBA is the area where noise levels are predicted to be above the noise behaviour criteria. It has a maximum spatial extent of 17.4 km radius around the Artisan-1 well whilst the MODU is moored on location. For conservatism 20 km was used as the noise behaviour EMBA. The EPBC Protected Matters Report for the light and noise behaviour EMBA is in Appendix A.3.
Noise 24 hr EMBA	The noise 24 hr EMBA is the area where noise levels are predicted to be above the TTS 24 hr criteria. It has a maximum spatial extent of 2.76 km radius around the Artisan-1 well whilst the MODU is moored on location. For conservatism 3 km was used as the noise 24 hr EMBA.

EMBA Zones	Description
	The EPBC Protected Matters Report for the noise 24 hr EMBA is in Appendix A.4.
Waste Water EMBA	The waste water EMBA is the area that may be affected by planned waste water discharges. It has a spatial extent of 2.5 km radius around the Artisan-1 well whilst the MODU is moored on location. The EPBC Protected Matters Report for the waste water EMBA is in Appendix A.5.

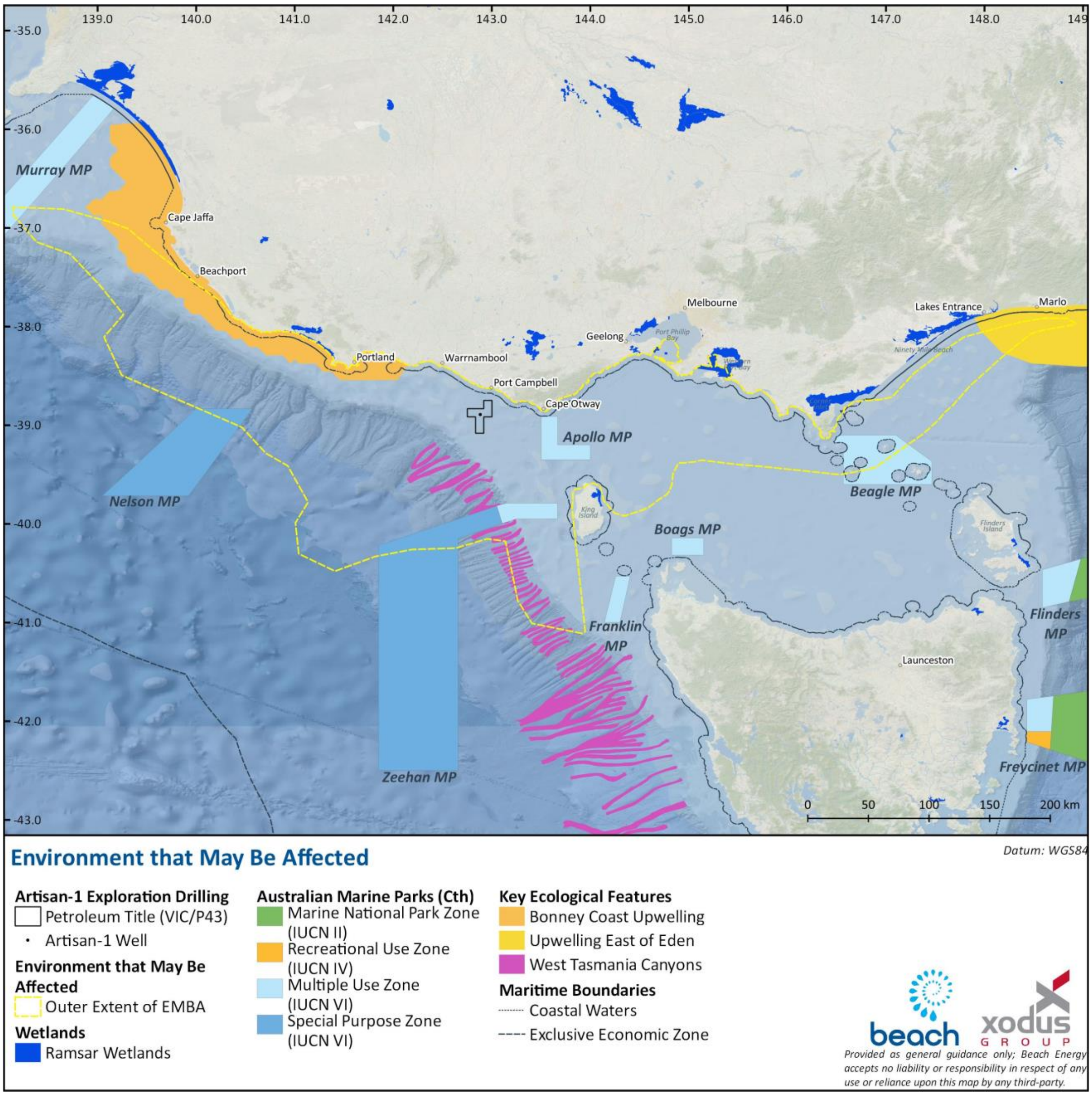


Figure 5-1: Environment that may be affected

5.2 Regulatory context

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

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

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

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

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

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

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

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

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

   i. Commonwealth marine area within the meaning of that Act; or
   ii. Commonwealth land within the meaning of that Act.

With regards to 13(3)(c), information on the ecological character of declared Ramsar wetlands is provided in section 5.5.5

With regards to 13(3)(d) and (e) more detail has been provided where listed Threatened or Migratory species have a spatially defined biologically important area (BIA) or habitat critical to survival – as they are spatially defined areas where aggregations of individuals of a regionally significant species are known to display biologically important behaviours such as breeding, foraging, resting or migration.

With regards to 13(3)(f) more detail has been provided in Section 5.5.11 for Key Ecological Features (KEFs) as they are considered as conservation values of the Commonwealth marine area; and in Section 5.5.1 for Australian Marine Parks (AMPs) as they are enacted under the EPBC Act.

5.3 Regional environmental setting

The operational area and EMBAs are 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 Otway Shelf, which have rocky reefs and soft sediments that support a wide range of species. The shelf break increases currents, eddies and upwelling, and the area is especially biodiverse, including species that are fished recreationally and commercially. There are seafloor canyons along the continental shelf which provide habitat for sessile invertebrates such as temperate corals. The Bonney coast upwelling KEF is an area of seasonally higher primary productivity which attracts baleen whales and other species (including EPBC-listed species) which feed on the plankton swarms (krill).

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

5.4 Summary of environmental receptors within the EMBA

The following tables list the presence of ecological (Table 5-2) and socio-economic and cultural (Table 5-3) receptors that may occur within the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs.

Values and sensitivities associated with each of the receptors have been included in the tables. These values and sensitivities have been identified based on:

- presence of listed Threatened or Migratory species or Threatened Ecological Communities (TEC) identified in the EPBC Protected Matter search (Appendix A).
- presence of BIAs and habitats critical to the survival of the species.
- presence of important behaviours (e.g. foraging, roosting or breeding) by fauna, including those identified in the EPBC Protected Matter search (Appendix A).
- important linkage to other receptors (e.g. nursery habitat, food source, commercial species).
- important benefit to human activities (e.g. recreation and tourism, aesthetics, economic benefit).

Table 5-2: Presence of ecological receptors within the operational area and EMBA

Receptor Type	Receptor Category	Values and Sensitivities	Presence: Operational Area	Presence: Spill EMBA	Presence: Light and Noise Behaviour EMBA	Presence: Noise 24 hr EMBA	Presence: Waste Water EMBA	Description and relevant management advice
Shoreline	Rocky	• foraging habitat (e.g. birds) • nesting or breeding habitat (e.g. birds, pinnipeds) • haul-out sites (e.g. pinnipeds)	×	✓	×	×	×	The Otway coast includes areas of rocky and sandy beaches. Each of these shoreline types has the potential to support different flora and fauna assemblage due to the different physical factors (e.g. waves, tides, light etc.) influencing the habitat; for example: • pinnipeds are known to use rocky shores for haul-out and/breeding. • bird species may use sandy, rocky or cliff areas for roosting and breeding sites. • cliff and rocky coasts can provide a hard substrate for sessile invertebrate species (e.g. barnacles, sponges etc) to attach.
	Sandy	• foraging habitat (e.g. birds) • nesting or breeding habitat (e.g. birds, pinnipeds) • haul-out sites (e.g. pinnipeds)	×	✓	×	×	×	
Mangroves	Intertidal/subtitle habitat, mangrove communities	• nursery habitat (e.g. crustaceans, fish) • breeding habitat (e.g. fish)	×	✓	×	×	×	Mangroves are not a dominant habitat along the Otway coast, but are known to occur further east within bays and wetlands (e.g. Western Port Bay, Corner Inlet). Mangrove habitat can provide foraging, nesting and nursery habitat for many species. *See Section 5.7.2 for more detail.*
Saltmarsh	Upper intertidal zone, saltmarsh habitat, habitat for fish and benthic communities	• nursery habitat (e.g. crustaceans, fish) • breeding habitat (e.g. fish)	×	✓	×	×	×	Saltmarsh, including the TEC 'Subtropical and Temperate Coastal Saltmarsh' is known to occur along the Otway coast. *See Section 5.7.3 for more detail.*
Soft sediment	Predominantly unvegetated soft sediment substrates	• key habitat (e.g. benthic invertebrates)	×	✓	×	×	×	The drilling activity will be conducted in water depths of approximately 71 m. Unvegetated soft sediments are a widespread habitat in both intertidal and subtidal areas, particularly in areas beyond the photic zone. The Middle Otway Shelf (typically 70–130 m depth) is a zone of large tracts of open sand with little or no epifauna to characterise the area: infaunal communities and bivalves, polychaetes and crustaceans dominate in the open sand habitat. *See Section 5.7.1.1 for more detail.*
Seagrass	Seagrass meadows	• nursery habitat (e.g. crustaceans, fish) • food source (e.g. fish, turtles)	×	✓	×	×	×	Seagrass typically occurs on soft sediment substrates within the photic zone (i.e. intertidal and shallow subtidal areas). Seagrass is known to occur in the nearshore area of the Otway coast, including within protected areas (e.g. Twelve Apostles Marine Park). *See Section 5.7.1.2 for more detail.*
Algae	Macroalgae	• nursery habitat (e.g. crustaceans, fish) • food source (e.g. birds, fish)	×	✓	×	×	×	Macroalgae can occur on rocky substrates within the photic zone (i.e. intertidal and shallow subtidal areas). Macroalgae is known to occur in the nearshore area of the Otway coast, including within protected areas (e.g. Twelve Apostles Marine Park). During video surveys, only in waters shallower than approximately 20 m, was an area of significant, high profile reef and associated high density macroalgae dominated epibenthos encountered. *See section 5.7.1.3 for more detail.*
Coral	Soft corals, hard corals	• nursery habitat (e.g. crustaceans, fish) • breeding habitat (e.g. fish)	✓	✓	✓	✓	✓	Hard corals will typically occur in shallower (<50 m) waters. They are not a dominant feature of reef habitat within the SEMR, but their presence has been recorded around Cape Otway and within the Wilsons Promontory National Park. Soft corals are typically present in deeper waters throughout the continental shelf, slope and off slope regions, to well below the limit of light penetration. Soft corals are typically smaller and often solitary. *See Section 5.7.1.4 for more detail.*
Plankton	Phytoplankton and zooplankton	• food source (e.g. fish, cetaceans, marine turtles)	✓	✓	✓	✓	✓	Phytoplankton and zooplankton are widespread throughout oceanic environments. *See Section 5.7.4 for more detail.*

Receptor Type	Receptor Category	Values and Sensitivities	Presence: Operational Area	Presence: Spill EMBA	Presence: Light and Noise Behaviour EMBA	Presence: Noise 24 hr EMBA	Presence: Waste Water EMBA	Description and relevant management advice
Marine invertebrates	Benthic and pelagic invertebrates	• food source (e.g. fish)	✓	✓	✓	✓	✓	A variety of invertebrate species may occur within the operational area and EMBAs, including sponges and arthropods. Shallower (typically <70 m) areas of the Otway Shelf contain areas of exposed limestone substrate that can host variable densities of encrusting mollusc, sponge, bryozoan and red algae assemblages. *See Section 5.7.5 for more detail.*
		• commercial species	✓	✓	✓	✓	✓	Commercially important species (e.g. rock lobster, giant crab) may occur within the operational area and EMBAs. *See Section 5.8.7, 5.8.8 and 5.8.9 for more detail.*
Fish	Fish (including fish and sharks)	• listed marine species • listed Threatened species • listed Migratory species • BIA	✓	✓	✓	✓	✓	A single threatened shark species, the white shark, is known to occur within the operational area. The following fish species (or species habitat) may occur within the EMBAs: • Australian grayling – light and noise behaviour and spill • porbeagle shark – light and noise behaviour, noise 24 hr, wastewater and spill • shortfin mako shark - light and noise behaviour, noise 24 hr, wastewater and spill • white shark - light and noise behaviour, noise 24 hr, wastewater and spill • whale shark - spill The EMBAs and the operational area are within a distribution BIA for the white shark. No habitat critical to the survival of the species or behaviours were identified. Relevant Management Advice: National Recovery Plan for the *Prototroctes maraena* (Australian Grayling) (Backhouse et al., 2008) Recovery Plan for the *Carcharodon carcharias* (white Shark) (DSEWPaC, 2013a) Approved Conservation Advice for *Rhincodon typos* (whale shark) (TSSC, 2015b) *See Section 5.7.7.3 for more detail.*
	Pipefish, seahorse, seadragons	• listed marine species	✓	✓	✓	✓	✓	Syngnathid species (or species habitat) may occur within the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs. No important behaviours or BIAs have been identified. No Management advice is applicable. *See Section 5.7.7.3 for more detail.*
Seabirds	Birds that live or frequent the ocean	• listed marine species • listed Threatened species • listed Migratory species • BIA	✓	✓	✓	✓	✓	23 listed seabird species (or species habitat) may occur within the operational area, 31 within the light and noise behaviour EMBA and 28 within the noise 24 hr EMBA and waste water EMBA. 105 seabird and shorebird species (or species habitat) may occur within the spill EMBA; with breeding, foraging and roosting behaviours identified. Both the operational area and the EMBAs intersect foraging BIAs for several albatross species (Antipodean albatross, black-browed albatross, Buller's albatross, Campbell albatross, Indian yellow-nosed albatross, shy albatross, wandering albatross); common diving-petrel and wedge-tailed shearwater. The light and noise behaviour EMBA also interests with the short-tailed shearwater foraging BIA. The spill EMBA also overlaps BIAs for Australasian gannet, black-faced cormorant, little penguin, short-tailed shearwater and the white-faced storm petrel. Roosting and breeding for a variety of bird species, wader birds and terns, occurs within the spill EMBA. Relevant Management Advice: refer to Table 3-4 for relevant plans and advice. *See Section 5.7.7.4 for more detail.*

Receptor Type	Receptor Category	Values and Sensitivities			Presence			
			Operational Area	Spill EMBA	Light and Noise Behaviour EMBA	Noise 24 hr EMBA	Waste Water EMBA	Description and relevant management advice
Marine reptiles	Marine turtles	• listed marine species • listed Threatened species • listed Migratory species	✓	✓	✓	✓		Three marine turtle species (or species habitat) may occur within the operational area or EMBAs: • loggerhead turtle; • green turtle; and • leatherback turtle. No BIAs or habitat critical to the survival of the species occur within the operational area or EMBAs. Relevant management advice: Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) Approved Conservation Advice for *Dermochelys coriacea* (leatherback turtle) (DEWHA, 2008) *See Section 5.7.7.7 for more detail.*
Cetaceans and pinnipeds	Seals, sea lions	• listed marine species	✓	✓	✓	✓	✓	The New Zealand and Australian fur-seal species or species habitat may occur within the operational area and EMBAs. Known breeding colonies and a haul-out site are present within the spill EMBA for the Australian fur-seal. A breeding colony is present within the spill EMBA for the New Zealand fur-seal. A foraging BIA for the Australian sea-lion is located west and north-west of Beachport within the spill EMBA. Relevant Management Advice: Conservation Listing Advice for the *Neophoca cinerea* (Australian sea lion) (TSSC 2010) Recovery Plan for the *Neophoca cinerea* (Australian sea lion) (DSEWPaC 2013). *See Section 5.7.7.7 for more detail.*
	Whales	• listed marine species • listed threatened species • listed migratory species • BIA	✓	✓	✓	✓	✓	Nine whale species (or species habitat) may occur within the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs, while 24 whale species (or species habitat) may occur within the spill EMBA. Using the PMST, foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); and breeding behaviour was identified for the southern right whale within the spill EMBA. The EMBAs and operational area intersects a foraging BIA for the pygmy blue whale and the southern right whale current core coastal range. The spill EMBA, also overlaps an aggregation BIA, connecting habitat BIA and a migration BIA for the southern right whale. Relevant Management Advice: Conservation Advice for humpback whales (TSSC, 2015a) The Conservation Management Plan for the blue whale (Commonwealth of Australia 2015b) The Conservation Management Plan for the southern right whale (DSEWPaC 2012a) Refer to the Conservation Advice in Table 3-4. *See Section 5.7.7.6 for more detail.*
	Dolphins	• listed marine species • listed Migratory species	✓	✓	✓	✓	✓	Four dolphin species (or species habitat) may occur within the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs: • dusky dolphin • common dolphin • bottlenose dolphin • Risso's dolphin • Indian Ocean Bottlenose Dolphin Two additional dolphin species (or species habitat) may occur within the spill EMBA: • southern right whale dolphin • Indian ocean bottlenose dolphin No important behaviours or BIAs have been identified. *See Section 5.7.7.6 for more detail*

Table 5-3: Presence of socio-economic and cultural receptors within the operational area and broader EMBA

Receptor Type	Receptor Category	Values and Sensitivities	Presence		
			Operational area, light and noise behaviour, noise 24 hr and waste water EMBAs	Spill EMBA	Description and relevant management advice
Commonwealth Marine Area	Australian Marine Park (AMP)	• aggregations of marine life	×	✓	No AMPs overlap the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. The AMPs that overlap the spill EMBA are: • Apollo; • Beagle; • Murray; • Nelson; and • Zeehan *See section 5.5.1 for more detail.* Relevant management advice: South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013).
	Key Ecological Feature (KEF)	• high productivity • aggregations of marine life	✓	✓	A single KEF, the Shelf Rocky Reefs and Hard Substrates, overlaps the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. The KEFs that overlap the spill EMBA are: • Bonney Coast Upwelling • upwelling east of Eden • West Tasmanian marine canyons • shelf rocky reefs and hard substrates • Bass Cascade *See Section 5.5.11 for more detail.* Relevant Management Advice is outlined in: South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) Parks Victoria Marine Protected Areas Program Plan 2012-2014 (Parks Victoria, 2012)
	Threatened Ecological Communities (TECs)	• wildlife corridors • aggregations of marine life	×	✓	No TECs overlap the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. The TECs that overlap the spill EMBA are: • 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 *See Section 5.7.6 for more detail.* Relevant Management Advice: South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) Parks Victoria Marine Protected Areas Program Plan 2012-2014 (Parks Victoria, 2012)
State Parks and Reserves	Marine Protected Areas	• aggregations of marine life	×	✓	No Marine Protected Areas overlap the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. Both Victoria and Tasmania have marine protected areas present within the spill EMBA. *See Sections 5.5.6 and 5.5.9 for more detail.* Relevant Management Advice: Parks Victoria Marine Protected Areas Program Plan 2012-2014 (Parks Victoria, 2012) Wilsons Promontory Marine National Park and Wilsons Promontory Marine Park Management Plan May 2006 (Parks Victoria, 2006a) Corner Inlet Marine National Park Management Plan (Parks Victoria, 2005a)

Receptor Type	Receptor Category	Values and Sensitivities	Presence		
			Operational area, light and noise behaviour, noise 24 hr and waste water EMBAs	**Spill EMBA**	**Description and relevant management advice**
					Bunurong Marine National Park Management Plan (Parks Victoria, 2006)
	Terrestrial Protected Areas	• aggregations of terrestrial life	×	✓	No Terrestrial Protected Areas overlap the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. Victoria and Tasmania have terrestrial protected areas present in the spill EMBA. *See Sections 5.5.8 and 5.5.10 for more detail.*
Wetlands of International Importance	Ramsar Wetlands	• aggregation, foraging and nursery habitat for marine life	×	✓	No Ramsar wetlands overlap the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. There are six Ramsar wetlands in the spill EMBA: • Corner Inlet • Glenelg Estuary and Discovery Bay • Lavinia • Piccaninnie Ponds Karst Wetlands • Port Phillip Bay (Western Shoreline) and Bellarine Peninsula • Western Port *See Section 5.5.5 for more detail.* Relevant Management Advice: Corner Inlet Ramsar site Ecological Character Description (BMT WBM, 2011) Corner Inlet Ramsar Site Strategic Management Plan (Parks Victoria, 2002a) Corner Inlet Ramsar Site Management Plan (WGCMA, 2014) Glenelg Estuary and Discovery Bay Ramsar Site Ecological Character Description (DELWP, 2017a) Glenelg Estuary and Discovery Bay Ramsar Site Management Plan (DEWLP, 2017c) Lavinia Ramsar Site Ecological Character Description. Lloyd Environmental (Newall and Lloyd, 2012) Piccaninnie Ponds Karst Wetlands Ecological Character Description (Butcher et al., 2011a) Piccaninnie Ponds Karst Wetlands Ramsar Management Plan (Butcher et al., 2011b) Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan (DELWP, 2018) Western Port Ramsar Site Management Plan (DELWP, 2017d) Western Port Ramsar Wetland Ecological Character Description. (Kellogg et al. 2010)
Commercial Fisheries	Commonwealth-managed	• economic benefit	✓	✓	The Commonwealth-managed fisheries that overlap the spill EMBA are: • Bass Strait Central Zone Scallop Fishery; • Eastern Tuna and Billfish Fishery; • Skipjack Tuna Fishery; • Small Pelagic Fishery; • Southern and Eastern Scalefish and Shark Fishery; • Southern Bluefin Tuna Fishery; and • Southern Squid Jig Fishery. AFMA have confirmed there is no fishing effort for Commonwealth fisheries within the operational area. *See section 5.8.7 for more detail.*
	Victorian State-managed	• economic benefit	✓	✓	The Victorian State-managed fisheries that overlap the spill EMBA are: • Rock Lobster Fishery; • Giant Crab Fishery; • Abalone Fishery; • Scallop (Ocean) Fishery; • Wrasse (Ocean) Fishery; and

Receptor Type	Receptor Category	Values and Sensitivities	Presence		
			Operational area, light and noise behaviour, noise 24 hr and waste water EMBAs	**Spill EMBA**	**Description and relevant management advice**
					• Snapper Fishery. Based on data from Victorian Fishing Authority (VFA) (2014 to 2018) the above listed fisheries have catch effort within the spill EMBA, however, only the Southern rock lobster have catch effort within the operational area. *See section 5.8.8 for more detail.*
	Tasmanian State-managed	• economic benefit	×	✓	No Tasmanian State-managed fisheries overlap the operational area. The Tasmanian State-managed fisheries that overlap the spill EMBA are: • Abalone Fishery • Commercial Dive Fishery • Giant Crab Fishery • Rock Lobster Fishery • Scalefish Fishery • Scallop Fishery • Seaweed Fishery • Shellfish Fishery Based on historic catch assessments, only the following are expected to be active within the spill EMBA: • Abalone Fishery • Commercial Dive Fishery • Giant Crab Fishery • Rock Lobster Fishery • Scalefish Fishery • Seaweed Fishery *See section 5.8.9 for more detail.*
Recreational Fisheries	State-managed	• community • recreation	×	✓	Recreational fishing is popular in Victoria largely centred within Port Phillip Bay and Western Port. Recreational fisheries that occur within the spill EMBA are: • Rock lobster • Finfish • Abalone • Scallops • Squid • Pipi *See section 5.8.6 for more detail.*
Recreation and Tourism	Various human activities and interaction	• community • recreation • economic benefit	×	✓	Consultation has identified the key areas of tourism in the region include sightseeing, chartered vessels, diving and fishing. *See section 5.8.5 and 5.8.6 for more detail.*
Industry	Shipping	• community • economic benefit	✓	✓	The SEMR is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania. *See section 5.8.4 for more detail.*
	Petroleum exploration and production	• economic benefit	×	✓	Petroleum exploration has been undertaken within the Otway Basin since the early 1960s. The Cooper Energy Casino-Henry fields and pipeline and Minerva field and pipeline are within the spill EMBA. Given the activity is wholly within a Beach petroleum title, only the drilling activity will occur within the title during the drilling activity. There are currently no petroleum activities planned within 20 km of the Artisan-1 location. *See sections 5.8.2 and 5.8.3 for more detail.*
Heritage	Maritime	• shipwrecks	×	✓	There are over 200 historic shipwrecks in the spill EMBA; however only one with a

Receptor Type	Receptor Category	Values and Sensitivities	Presence		
			Operational area, light and noise behaviour, noise 24 hr and waste water EMBAs	**Spill EMBA**	**Description and relevant management advice**
					protection zone within the EMBA, the *SS Alert*. *See section 5.9.1 for more detail.*
	Cultural	• World Heritage Properties • Commonwealth Heritage Places • National Heritage Places	×	✓	There are no World Heritage Properties present within the operational area, light and noise behaviour, noise 24 hr, waste water or spill EMBAs. There are eight Commonwealth Heritage Places, only two of which include natural coastal areas within the spill EMBA: • HMAS Cerberus Marine and Coastal Area (Natural, Listed place) • Swan Island and Naval Waters (Natural, Listed place) There are three places of National Heritage that were identified by the PMST report but are located onshore, outside the spill EMBA and do not have marine or coastal components. *See sections 5.9.2 and 5.9.3 for more detail.*

5.5 Conservation values and sensitivities

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

No conservation vales or sensitivities were identified in the operational area, light and noise behaviour, noise 24 hr or waste water EMBAs.

5.5.1 Australian Marine Parks

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

The PMST report for the spill EMBA (Appendix A.1) identified five Australian Marine Parks (AMPs):

- Apollo
- Beagle
- Murray
- Nelson
- Zeehan

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

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

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

5.5.1.1 Apollo AMP

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

The major conservation values of the Apollo AMP are:

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

5.5.1.2 Beagle AMP

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

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

The major conservation values of the Beagle AMP are:

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

5.5.1.3 Murray AMP

The Murray AMP lies south of the mouth of the Murray River, off the South Australian coast and stretches out to Australia's exclusive economic zone limit, more than 400 km out to sea, covering an area of 25,803 km^2 (DNP, 2013). It spans an extensive area across the Lacepede Shelf, continental slope and deeper water ecosystems that extend from South Australia to Tasmania. The reserve contains the Murray Canyon, which is considered one of the most spectacular geological formations on the Australian continent margin. The reserve is important for many marine species, including those migrating through its inshore waters. The southern right whale uses the inshore area of the reserve to nurse its young. Offshore, many seabird species can be seen foraging.

The major conservation values of the Murray AMP are:

- examples of ecosystems, habitats and communities associated with: the Spencer Gulf Shelf Province, the Southern Province, the West Tasmanian Transition and associated with seafloor features: abyssal plain/deep ocean floor, canyon, escarpment, knoll/abyssal hill, shelf, slope, terrace.
- features with high biodiversity and productivity: Bonney coast upwelling, shelf rocky reefs and hard substrate.

- important foraging areas for: blue, sei and fin whales, Australian sea lion, wandering, black-browed, yellow-nosed and shy albatrosses, great-winged petrels, flesh-footed and short-tailed shearwaters, and white-faced storm petrel.
- important breeding area for the southern right whale and important migration area for the humpback whale (DNP, 2013).

5.5.1.4 Nelson AMP

The Nelson AMP spans the deepwater ecosystems (greater than 3,000 m depth) extending from South Australia to the west of Tasmania (DNP, 2013). The reserve spans a range of geological features including plateaus, knolls, canyons and the abyssal plain (a large area of extremely flat or gently sloping ocean floor just offshore from the continent). The knoll features provide a rocky substrate above the abyssal plain. Little is known about the benthic biodiversity of this reserve; however, marine mammals are known to occur here.

The major conservation values of the Nelson AMP are:

- examples of ecosystems, habitats and communities associated with the West Tasmanian Transition and associated with the seafloor features including the abyssal plain/deep ocean floor, canyon, knoll/abyssal hill, plateau and slope
- important migration area for humpback, blue, fin and sei whales (DNP, 2013).

5.5.1.5 Zeehan AMP

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

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

The major conservation values for the Zeehan AMP are:

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

5.5.2 World Heritage Properties

The PMST Reports (Appendix A) did not identify any marine or coastal World Heritage Areas in the vicinity of the operational area, light and noise behaviour, noise 24 hr, waste water or spill EMBAs.

5.5.3 National Heritage Places

The places of National Heritage that were identified in the spill EMBA PMST Report (Appendix A.1) are located onshore; outside the spill EMBA and do not have marine or coastal components. These are:

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

5.5.4 Commonwealth Heritage Places

The spill EMBA PMST Report (Appendix A.1) identified eight Commonwealth Heritage Places, most of which are historic heritage places located on land and therefore are outside the spill EMBA. The eight heritage places are:

- HMAS Cerberus Marine and Coastal Area (Natural, Listed place)
- Swan Island and Naval Waters (Natural, Listed place)
- Cape Wickham Lighthouse (Historic, Listed place)
- Fort Queenscliff (Historic, Listed place)
- HMAS Cerberus Central Area Group (Historic, Listed place)
- Sorrento Post Office VIC (Historic, Listed place)
- Swan Island Defence Precinct (Historic, Listed place)
- Wilsons Promontory Lighthouse (Historic, Listed place)

Two of these heritage places include natural coastal areas within the spill EMBA; HMAS Cerberus Marine and Coastal Area and Swan Island (and Naval Waters). These are discussed below.

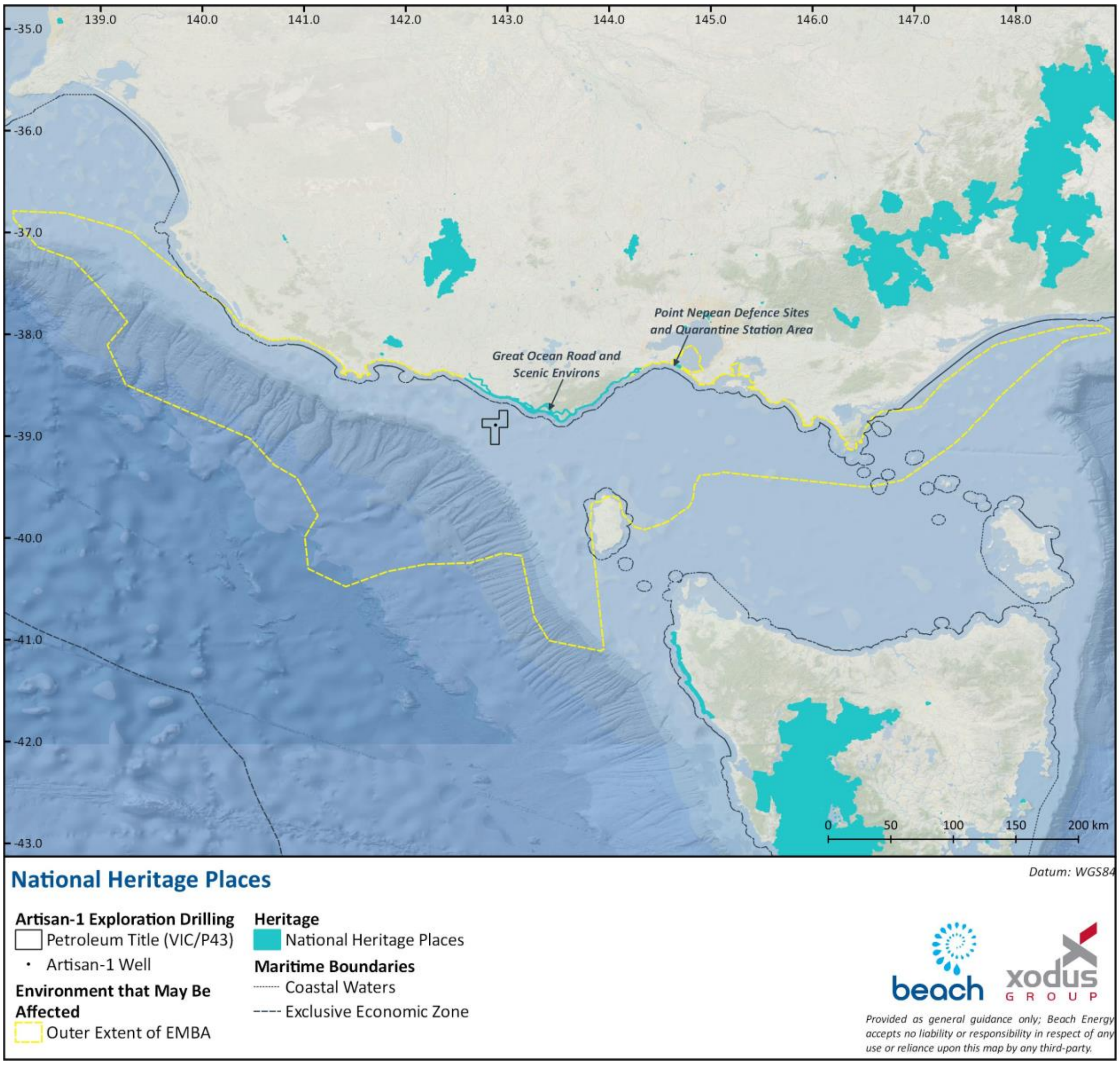


Figure 5-2: National Heritage Places present within the spill EMBA.

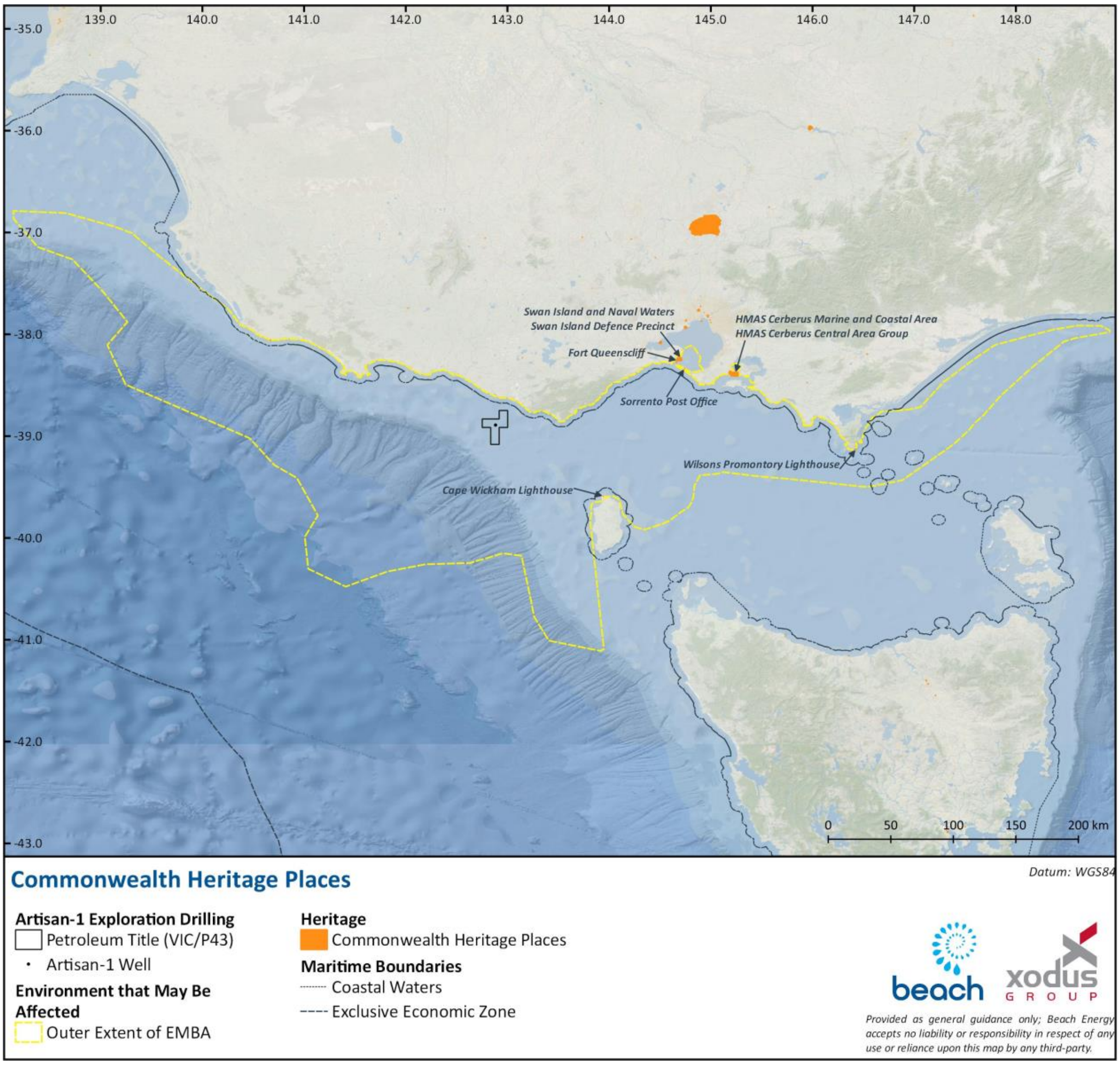


Figure 5-3: Commonwealth Heritage Places present within the spill EMBA.

5.5.4.1 HMAS Cerberus Marine and Coastal Area

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

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

- continuing shoreline progradation at Sandy Point reveals several stages in sand dune succession.

5.5.4.2 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 (DotEE, 2004b).

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 (S*terna nereis*) and provides the main roosting habitat in Swan Bay for the nationally endangered little tern (S*terna albifrons*) (DotEE, 2004b).

5.5.5 Wetlands of International Importance

The spill EMBA PMST Report (Appendix A.1) identified six marine or coastal Wetlands of International Importance (Ramsar-listed wetlands) (Figure 5-4). The ecological character and values of these Ramsar listed wetlands area described in the following sections.

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

Ecological character is the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time (Ramsar Convention 2005a). Changes to the ecological character of the wetland outside natural variations may signal that uses of the site or externally derived impacts on the site are unsustainable and may lead to the degradation of natural processes, and thus the ultimate breakdown of the ecological, biological and hydrological functioning of the wetland (Ramsar Convention 1996).

The ecological character description of a wetland provides the baseline description of the wetland at a given point in time and can be used to assess changes in the ecological character of these sites. Therefore, the baseline ecological character description of the Ramsar wetlands are described below. The potential to impact the ecological character of the wetlands is evaluated in the impact and risk assessments in Section 7.

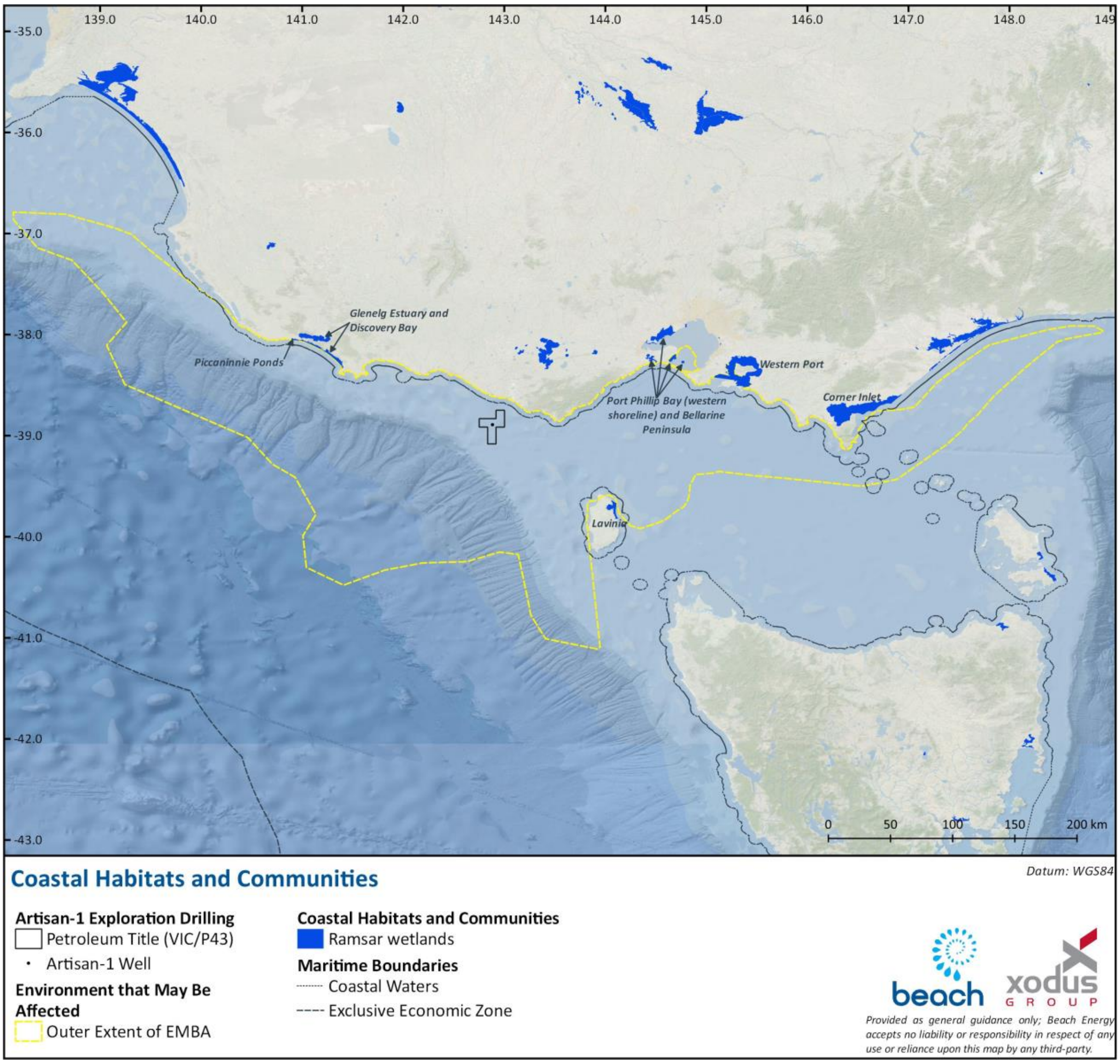


Figure 5-4: Ramsar wetlands within the spill EMBA

5.5.5.1 Corner Inlet

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

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

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

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

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

5.5.5.2 Port Philip Bay (Western shoreline) and Bellarine Peninsula

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

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

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

- representativeness – it includes all eight wetlands types.
- natural function – the interactions of physical, biological and chemical components of wetlands that enable them to perform certain natural functions and making them a vital element of the landscape.
- flora and fauna – contains the genetic and ecological diversity of the flora and fauna of the region, with at least 332 floral species (22 state threatened species) and 304 species of fauna (29 threatened species).
- waterbirds – provides habitat for migratory shorebirds, including some of international and national importance.
- cultural heritage – many aboriginal sites, particularly shell middens and artefact scatters have been found at the site.
- scenic – provide vistas of open water and marshland in a comparatively pristine condition.
- economic – use of natural resources in agriculture, fisheries, recreation and tourism.
- education and interpretation – offers a wide range of opportunities for education and interpretation of wildlife, marine ecosystems, geomorphological processes and various assemblages of aquatic and terrestrial vegetation.
- recreation and tourism – provides activities such as recreational fishing, birdwatching, hunting, boating, swimming, sea kayaking and camping and activities by commercial operators.
- scientific – site for long-term monitoring of waterbirds and waders.

5.5.5.3 Western Port

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

Western Port is approximately 60 km south-east of Melbourne, Victoria and in 1982 a large portion was specified of international importance especially as a Waterfowl Habitat (Rasmar Convention). 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 site (Yaringa, French Island and Churchill Island Marine Nation Parks). The Ramsar site is managed by DSE, Parks Victoria, the Victorian Channels Authority, Phillip Island Nature Park, Department of Defence and committees of Management under Crown Lands. There are numerous community and government projects that help monitor, protect, raise awareness and educate the community about the Rasmar site wetland (Brown and Root, 2010).

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

- supports a diversity and abundance of fish and recreational fishing.
- the soft sediment and reef habitats support a diversity and abundance of marine invertebrates.
- supports bird species, including 115 waterbird species, of which 12 are migratory waders of international significance.
- provides important breeding habitat for waterbirds, including listed threatened species.
- provides habitat to six species of bird and one fish species that are listed as threatened under the EPBC Act.
- rocky reefs comprise a small area within the Ramsar site, but includes the intertidal and subtidal reefs at San Remo, which support a high diversity, threatened community and Crawfish Rock, which supports 600 species (Shapiro, 1975).
- the Western Port Ramsar Site has three Marine National Parks, one National Park and has been designated as a Biosphere Reserve under the UNESCO's Man and the Biosphere program.
- the Ramsar site is within the traditional lands of the Boonwurrung, who maintain strong connections to the land and waters.
- the site contains the commercial Port of Hastings that services around 75 ships per year and contributes around $67 million annually to the region's economy.

5.5.5.4 Glenelg Estuary and Discovery Bay wetlands

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

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

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

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

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

5.5.5.5 Lavinia

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

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

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

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

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

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

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

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

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

5.5.5.6 Piccaninnie ponds karst wetlands

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

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

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

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

The geomorphic and hydrological features of the site produce a complex and biologically diverse ecosystem which supports considerable biodiversity, including a significant number of species of national and/or international conservation value. These include the orange-bellied parrot, Australasian bittern and Yarra pygmy perch.

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

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

5.5.6 Nationally Important Wetlands

The spill EMBA PMST Report (Appendix A.1) identified ten Nationally Important Wetlands (Figure 5-5).

5.5.6.1 Anderson Inlet

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

5.5.6.2 Lake Connewarre State Wildlife Reserve

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

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

5.5.6.3 Lake Flannigan

Lake Flannigan is an inland wetland on King Island, Tasmania and hence would not be impacted by a spill or any other aspects associated with the activity.

5.5.6.4 Lavinia Nature Reserve

Lavinia Nature Reserve (King Island, Tasmania) includes the Sea Elephant River Estuary and associated mudflats, areas of coastal swamp, lagoons and areas of drier marsh inland from the coast. The wetland area supports species and communities which are threatened in both Tasmania and/or globally.

Refer to description in Section 5.5.5 Wetlands of International Importance.

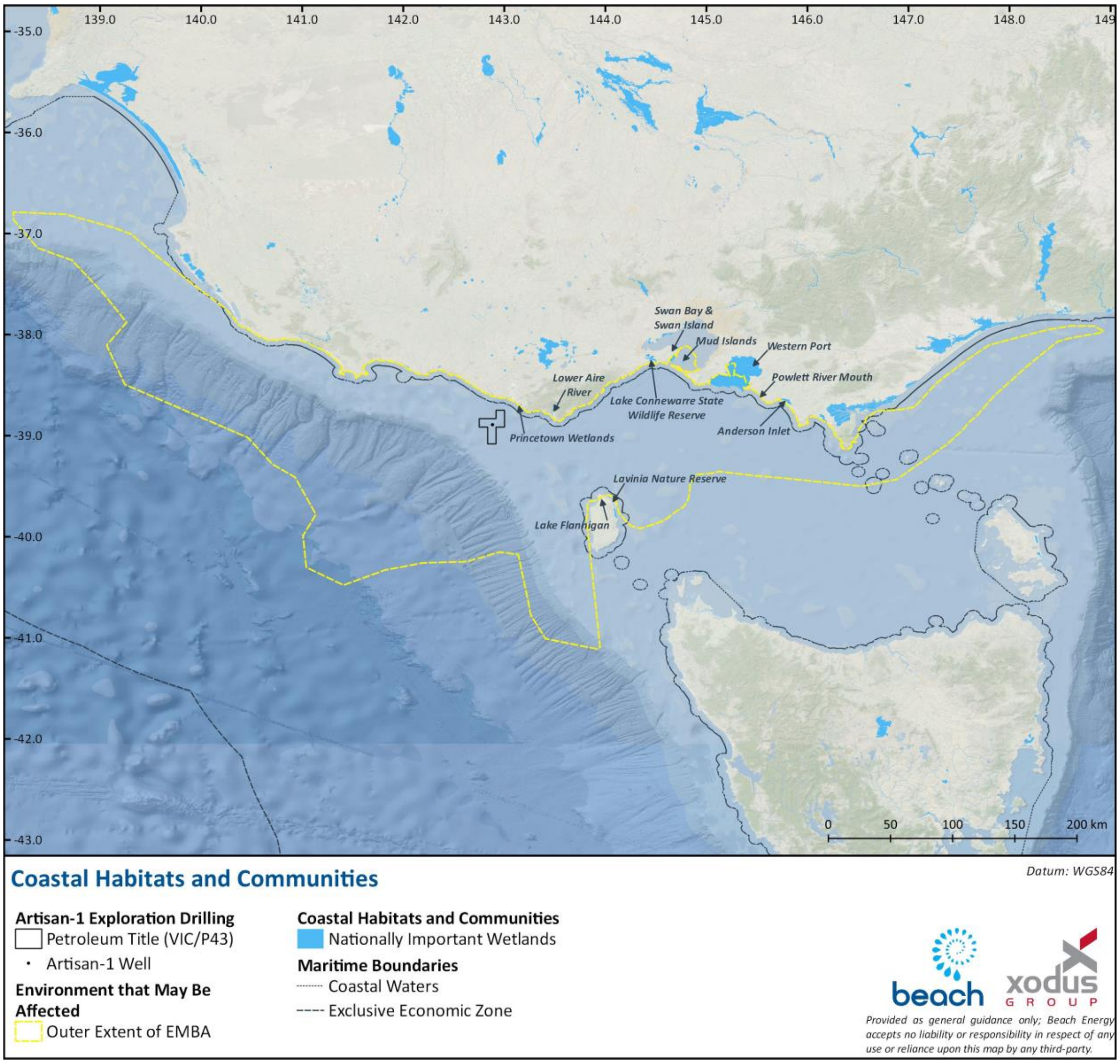


Figure 5-5: Nationally Important Wetlands within the spill EMBA

5.5.6.5 Lower Aire River Wetlands

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

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

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

5.5.6.6 Mud Islands

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.

5.5.6.7 Powlett River Mouth

The Powlett River Mouth provides valuable habitat for the endangered Orange-bellied Parrot. The Powlett River Mouth area supports saltmarsh vegetation which is the required habitat of the Orange-bellied Parrot.

5.5.6.8 Princetown Wetlands

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

The Princetown Wetlands have extensive beds of Common Reed (*Phragmites australis)* and meadows dominated by Beaded Glasswort which can support large numbers of waterbirds.

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

5.5.6.9 Swan Bay and Swan Island

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.

5.5.6.10 Western Port

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

Refer to description in Section 5.5.5Wetlands of International Importance.

5.5.7 Victorian Protected Areas – Marine

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

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

Seven Marine National Parks and seven marine sanctuaries are located within the spill EMBA as shown in Figure 5-6.

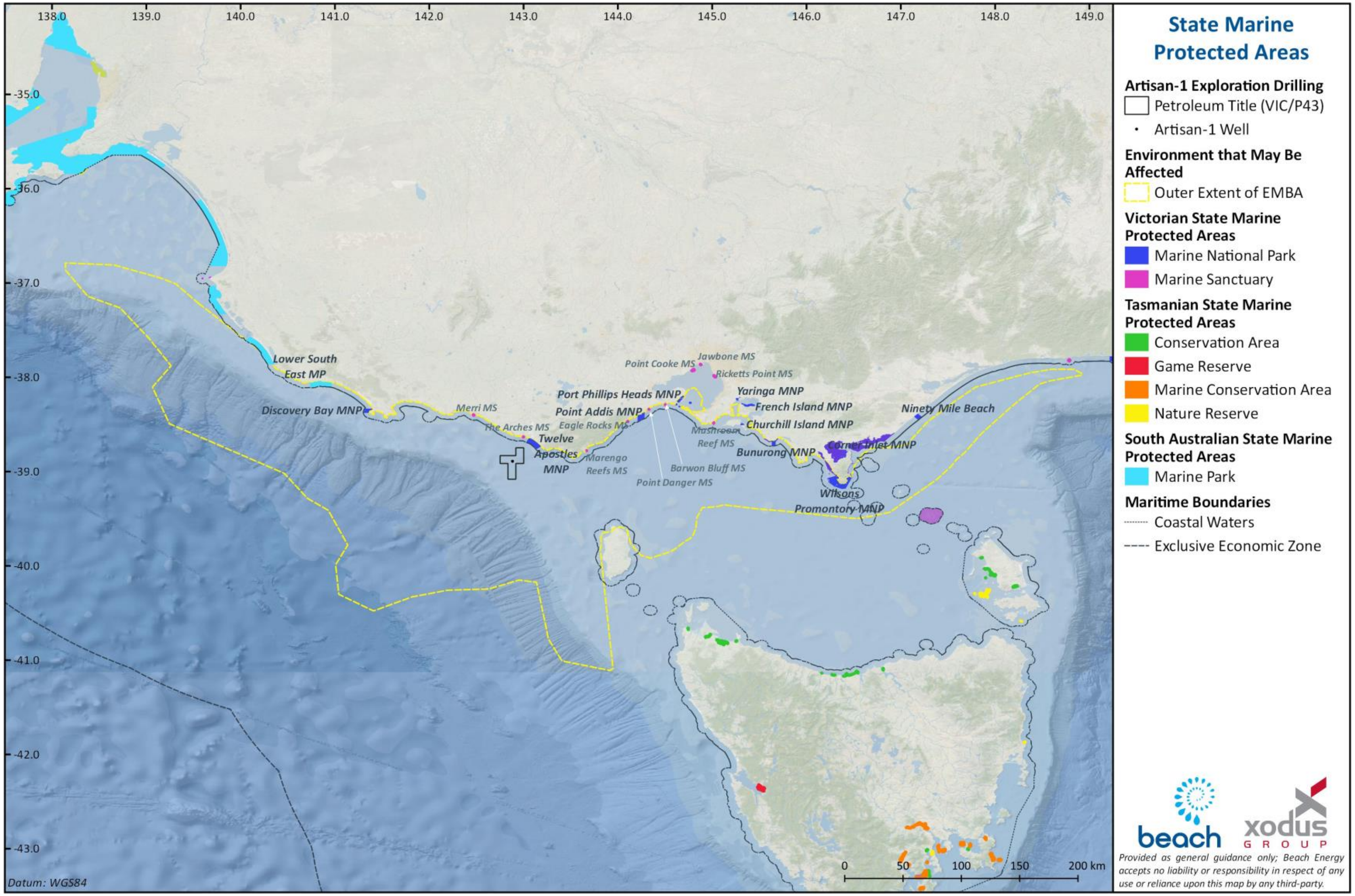


Figure 5-6: State Marine Protected Areas within the spill EMBA

5.5.7.1 Bunurong Marine National Park

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

- extensive intertidal rock platforms and subtidal rocky reefs with a geology and form that is uncommon along the Victorian coast.
- abundant and diverse marine flora and fauna including over 22 species of marine flora and fauna recorded, or presumed to be, at their eastern or western distributional limits (Plummer et al., 2003).
- highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone (ECC 2000).
- a high proportion of the common invertebrates occurring along the Victorian coast.
- high diversity of vegetation communities, many of which are considered rare, depleted or endangered within the region (WGCMA, 2003; Carr, 2003).
- important coastal habitat for several threatened species.
- spectacular coastal scenery, featuring rugged sandstone cliffs, rocky headlands, intertidal rock platforms and sandy cove.
- Eagles Nest, a prominent rock stack, recognised as a site of national geological and geomorphological significance (Buckley 1993).
- one of the richest Mesozoic fossil areas in Victoria.
- landscape and seascape of cultural significance to Indigenous people.
- numerous places and objects of significance to Indigenous people.
- a European history rich in diversity, including sites associated with shipping, coal mining, holidaying and living on the coast.
- two historical shipwrecks listed on the Victorian Heritage Register (Heritage Victoria, 2004).
- opportunities for cultural values investigation in an area protected from human disturbance.
- extensive subtidal reefs with magnificent underwater seascapes, offering numerous opportunities for diving and snorkelling.
- highly accessible intertidal rock platforms offering opportunities for rock-pooling, marine education and interpretation.
- spectacular coastal drive, with numerous lookouts and panoramic views of the coast and surrounding waters.
- coastline offering opportunities for swimming, surfing, boating, fishing and rock-pooling in a natural setting.
- the Bunurong Marine National Park is classified as IUCN II (National Parks) and the Bunurong Marine Park as IUCN IV (Habitat/species management area).

5.5.7.2 Churchill Island Marine National Park

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

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

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

5.5.7.3 Discovery Bay Marine National Park

The Discovery Bay Marine National Park is situated 20 km west of Portland and covering 2,770 ha and covers part of the largest coastal basalt formation in western Victoria. In deep water (30 – 60 m) there are low reefs forms from ancient shorelines or dunes. There is a rich diversity of marine life within this park due to the cold, nutrient rich waters of the area. The deep calcarenite reefs support diverse sponge gardens whilst the shallower reefs support the brown alga *Ecklonia radiata*. The offshore waters support a diverse array of invertebrates including southern rock lobster, black-lip abalone and gorgonians. The waters also support great white sharks and blue whales during the summer breeding season. The Discovery Bay National Park is protected as part of the Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (Parks Victoria, 2015) which covers over 116,000 ha of public land and freehold Gunditjmaraland in south-western Victoria. The Plan (Parks Victoria, 2015) describes some key values of the Discovery Bay (which includes the National Park and the coastal reserve), namely;

- recognised roosting, feeding and nesting area for birds such as the hooded plover.
- important habitat for the orange-bellied parrot.
- subtidal reefs with giant kelp forest communities (TEC).
- a foredune and dune complex that was formerly recognised on the National Estate.
- surfing, boating and passive recreation.
- tourism such as dune buggy tours.

5.5.7.4 Point Addis Marine National Park

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 following environmental, cultural and social values for the parks and sanctuaries:

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

5.5.7.5 Port Phillip Heads Marine National Park

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.

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

5.5.7.6 Twelve Apostles Marine National Park

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

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

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

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

- unique limestone rock formations, including the Twelve Apostles.
- a range of marine habitats representative of the Otway marine bioregion.
- indigenous culture based on spiritual connection to sea country and a history of marine resource use.
- the wreck of the Loch Ard (shipwreck).
- underwater limestone formations of arches and canyons.
- a diverse range of encrusting invertebrates.
- a spectacular dive site (Parks Victoria, 2006b).

5.5.7.7 Wilsons Promontory Marine National Park

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

- granite habitats, which are unusual in Victorian marine waters, including extensive heavy reefs with smooth surfaces, boulders and rubble and low-profile reefs.
- biological communities with distinct biogeographic patterns, including shallow subtidal reefs, deep subtidal reefs.
- intertidal rocky shores, sandy beaches, seagrass and subtidal soft substrates.
- abundant and diverse marine flora and fauna, including hundreds of fish species and invertebrates such as sponges, ascidians, sea whips and bryozoans.
- 68 species of marine flora and fauna recorded, or presumed to be, at their eastern or western distributional limits.
- important breeding sites for a significant colony of Australian fur seals.

- important habitat for several threatened shorebird species, including species listed under international migratory bird agreements.
- outstanding landscapes, seascapes and spectacular underwater scenery.
- seascape, cultural places and objects of high traditional and cultural significance to Indigenous people.
- Indigenous cultural lore and interest maintained by the Gunai / Kurnai and Boonwurrung people.
- important maritime and other history.
- historic shipwrecks, many of which are listed on the Victorian Heritage Register (Parks Victoria, 2006a).

5.5.7.8 Marengo Reefs Marine Sanctuary

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

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

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

5.5.7.9 The Arches Marine Sanctuary

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

5.5.7.10 Barwon Bluff Marine Sanctuary

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

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

5.5.7.11 Eagle Rock Marine Sanctuary

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

5.5.7.12 Merri Marine Sanctuary

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

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

- culturally significant to indigenous communities that have a long association with the area
- Merri River, wetlands and islands and headlands provide a variety of habitats

- provision of nursery for many fish species and habitat for algal species, hardy invertebrates and shorebirds.

5.5.7.13 Mushroom Reef Marine Sanctuary

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

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

5.5.7.14 Point Danger Marine Sanctuary

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

5.5.8 Victorian Protected Areas – Terrestrial

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

Figure 5-7 details that there are several Victorian National Parks, Coastal Parks and Wildlife Reserves within the spill EMBA.

5.5.8.1 Bay of Islands Conservation Park

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

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

5.5.8.2 Cape Liptrap Conservation Park

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

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

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

5.5.8.3 Cape Nelson State Park

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

5.5.8.4 Discovery Bay Coastal Park

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

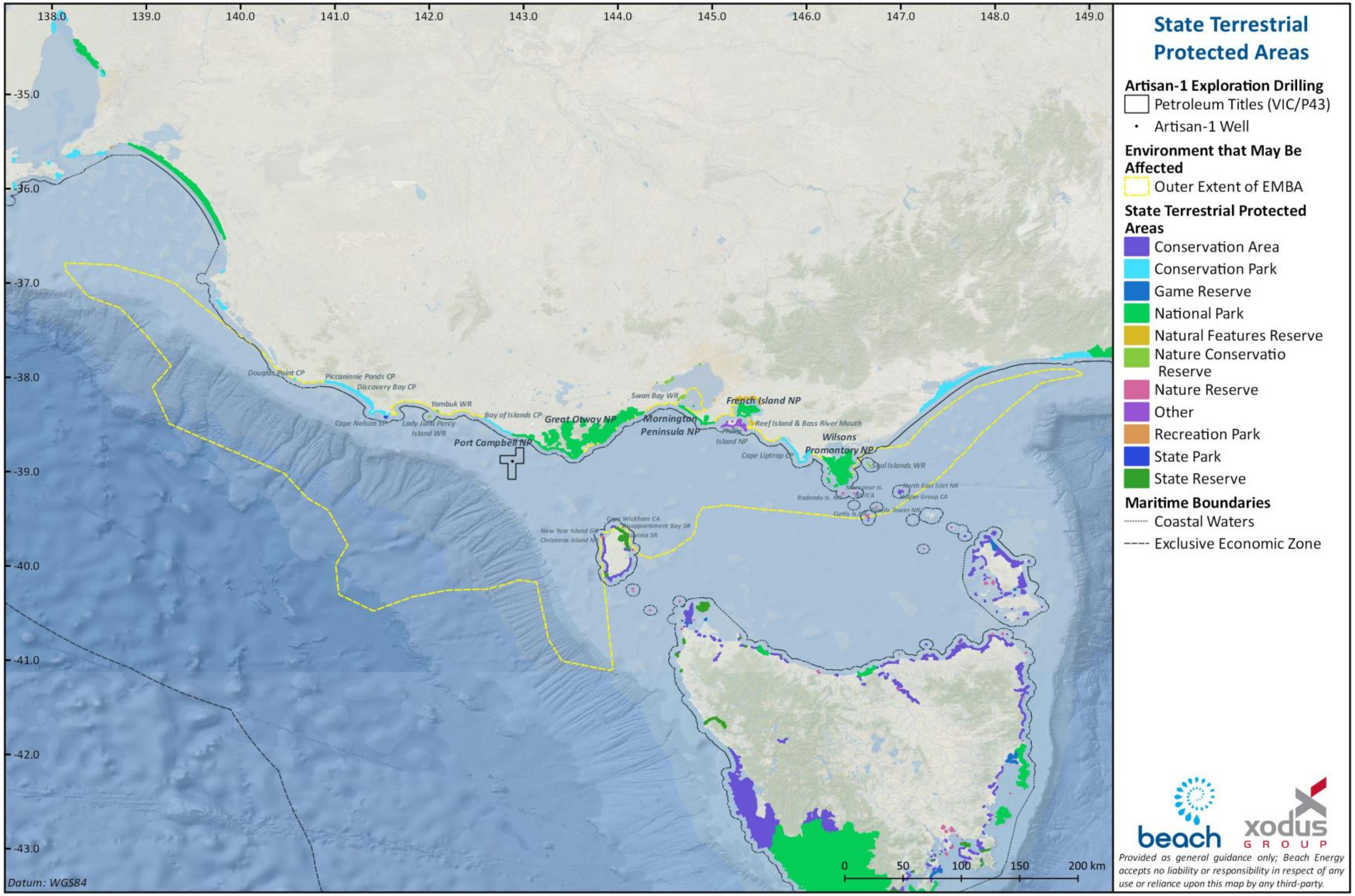


Figure 5-7: State Terrestrial Protected Areas within the spill EMBA

5.5.8.5 Douglas Point Conservation Park

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

5.5.8.6 French Island National Park

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

5.5.8.7 Great Otway National Park

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

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

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

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

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

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

5.5.8.8 Lady Julia Percy Island Wildlife Reserve

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

5.5.8.9 Mornington Peninsula National Park

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

- largest and most significant remaining areas of native vegetation on the Mornington Peninsula. Numerous sites and features of geomorphic significance, particularly along the coast (cliffed calcarenite coast sandy forelands and basalt shore platforms).
- only representation in the Victorian conservation reserve system of four land systems formed within the Southern Victorian Coastal Plains and the Southern Victorian Uplands.
- many significant native plants and vegetation communities, especially in Greens Bush and former McKellar Flora Reserve, and the most extensive remnant coastal grassy forest habitat on the Mornington Peninsula.
- highly scenic landscape values along the ocean coast and at Port Phillip heads and the prominent landscape feature of Arthurs Seat.
- many significant fauna species, including populations of the nationally significant hooded plover, over 30 species of State significance and many species of regional significance.
- high quality marine and intertidal habitats, with some pristine areas within Point Nepean.
- nationally significant and fascinating historic sites at Point Nepean.
- the historic Seawinds Gardens in Arthurs Seat State Park.
- one of the highest recorded densities of Aboriginal archaeological sites along the Victorian Coast
- South Channel Fort is an important component of the historic fortification defence system of Port Phillip (and an important bird nesting and roosting site).
- spectacular scenery and popular surf beaches associated with a wild and rugged coastline.
- local and regional economic benefits.
- intensively used recreational nodes, e.g. at Portsea, Sorrento, Cape Schanck and Arthurs Seat.

5.5.8.10 Phillip Island Nature Park

Phillip Island is east of Melbourne and forms a natural breakwater for the shallow waters of Western Port. Phillip Island is Biologically Important Area (BIA) for the little penguin, with breeding and foraging sites present (Commonwealth of Australia, 2015a). There is no management plan for Phillip Island Nature Park.

5.5.8.11 Piccaninnie Ponds Conservation Park

The Piccaninnie Pond covers an area of 8.64km^2, that has a wide diversity of fauna and flora with 60 bird species and six vegetation communities. Other vegetation found within the park includes reeds, sedge swamp, open heath and tussock grassland.

5.5.8.12 Port Campbell National Park

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

5.5.8.13 Reef Island and Bass River Mouth Nature Conservation Reserve

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

5.5.8.14 Seal Island Wildlife Reserve

Seal Islands is east of Wilsons Promontory. Seal Island is one of the two largest breeding sites for the Australian fur seal (Commonwealth of Australia, 2015a). There is no management plan for Seal Islands Wildlife Reserve.

5.5.8.15 Swan Bay Wildlife Reserve

Swan Bay Wildlife Reserve is an internationally recognized wetland and marine ecosystem within Port Phillip Bay. Swan Bay supports diverse saltmarsh communities which form part of the habitat critical for survival of the endangered orange bellied parrot and is an important recreational and tourism resource (AANRO, 1991).

5.5.8.16 Wilsons Promontory National Park

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

- entire promontory of national, geological and geomorphological significance containing a number of sites of State and regional significance.
- diverse vegetation communities, including warm temperate and cool temperate rainforest, tall open forests, woodlands, heathlands, and swamp and coastal communities.
- unmodified rivers and streams with no introduced fish species.
- half of Victoria’s bird species.
- intertidal mudflats, which are an internationally important habitat for migratory wading birds.
- the largest coastal wilderness area in Victoria.
- numerous middens and other significant Aboriginal sites.

- remains of sites of several small European settlements and past uses including timber milling, mining and grazing.
- a number of shipwrecks in the waters around Wilsons Promontory.
- the heritage buildings of Wilsons Promontory Light Station.
- outstanding natural landscapes including spectacular and diverse coastal scenery.

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

5.5.8.17 Yambuk Wetlands Natural Conservation Reserve

Yambuk Wetlands Natural Conservation Reserve is located south of Lake Yambuk along the coastline with an area of 0.77km^2 (Protected Planet, 2019).

5.5.9 Tasmanian Protected Areas - Marine

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

As per Figure 5-6 there are no marine Tasmanian Protected Areas within the spill EMBA.

5.5.10 Tasmanian Protected Areas – Terrestrial

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

Figure 5-7 details that there are several Tasmanian National Reserves, Conservations Areas and Game Reserves within the spill EMBA.

5.5.10.1 Cape Wickham Conservation Area

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

5.5.10.2 Christmas Island Nature Reserve

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

5.5.10.3 Curtis Island Nature Reserve

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

5.5.10.4 Devils Tower Nature Reserve

Devils Tower are two small granite islands which are part of the Curtis Group and are located in the Bass Strait between Wilsons Promontory and Tasmania. It is designated IUCN 1a which is a strict nature reserve, which allows minimal human use (DPIPWE, 2015) and is noted as being important for breeding seabirds and waders. There is no management plan for the Curtis Island Nature Reserve.

5.5.10.5 Disappointment Bay State Reserve

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

5.5.10.6 East Moncoeur Island Conservation Area

East Moncoeur Island is part of Tasmania's Rodondo Group. It is designated as IUCN Category V which is a protected landscape/seascape. There is no management plan for the East Moncoeur Island Conservation Area.

5.5.10.7 West Moncoeur Island Nature Reserve

West Moncoeur Island Nature Reserve is an area of 0.14 km^2 that is situated 2.5 km east of East Moncoeur Island. West Moncoeur is part of the Rodondo Group It supports large breeding colonies of Australia fur-seals (Carlyon et al, 2015).

5.5.10.8 Hogan Group Conservation Area

The Hogan Group is 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, 2011). It is designated as IUCN Category IV which is habitat/species management area. There is no management plan for the Hogan Group Conservation Area.

5.5.10.9 Lavinia State Reserve

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

5.5.10.10 New Year Island Game Reserve

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

5.5.10.11 North East Islet Nature Reserve

North East Islet (or Boundary Islet) is part of the Hogan Island Group. It is a haul-out site for the Australia fur-seal (Carlyon et al, 2011).

5.5.10.12 Rodondo Island Nature Reserve

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

5.5.11 South Australian Protected Areas - Marine

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

One South Australian marine park, the Lower South East Marine Park, was identified in the spill EMBA (Figure 5-6).

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.
- 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.

5.5.12 South Australian Protected Areas - Terrestrial

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

As per Figure 5-6 there are no terrestrial South Australian Protected Areas within the spill EMBA.

5.5.13 Key Ecological Features

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

The spill EMBA PMST Report (Appendix A.1) identified three KEFs:

- Bonney Coast Upwelling
- Upwelling East of Eden
- West Tasmanian Marine Canyons

The following KEFs were also identified as potentially occurring within the spill EMBA:

- Shelf Rocky Reefs and Hard Substrates
- Bass Cascade

Figure 5-8 details the KEFs within the spill EMBA.

No KEFs where identified within the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs (Figure 5-9).

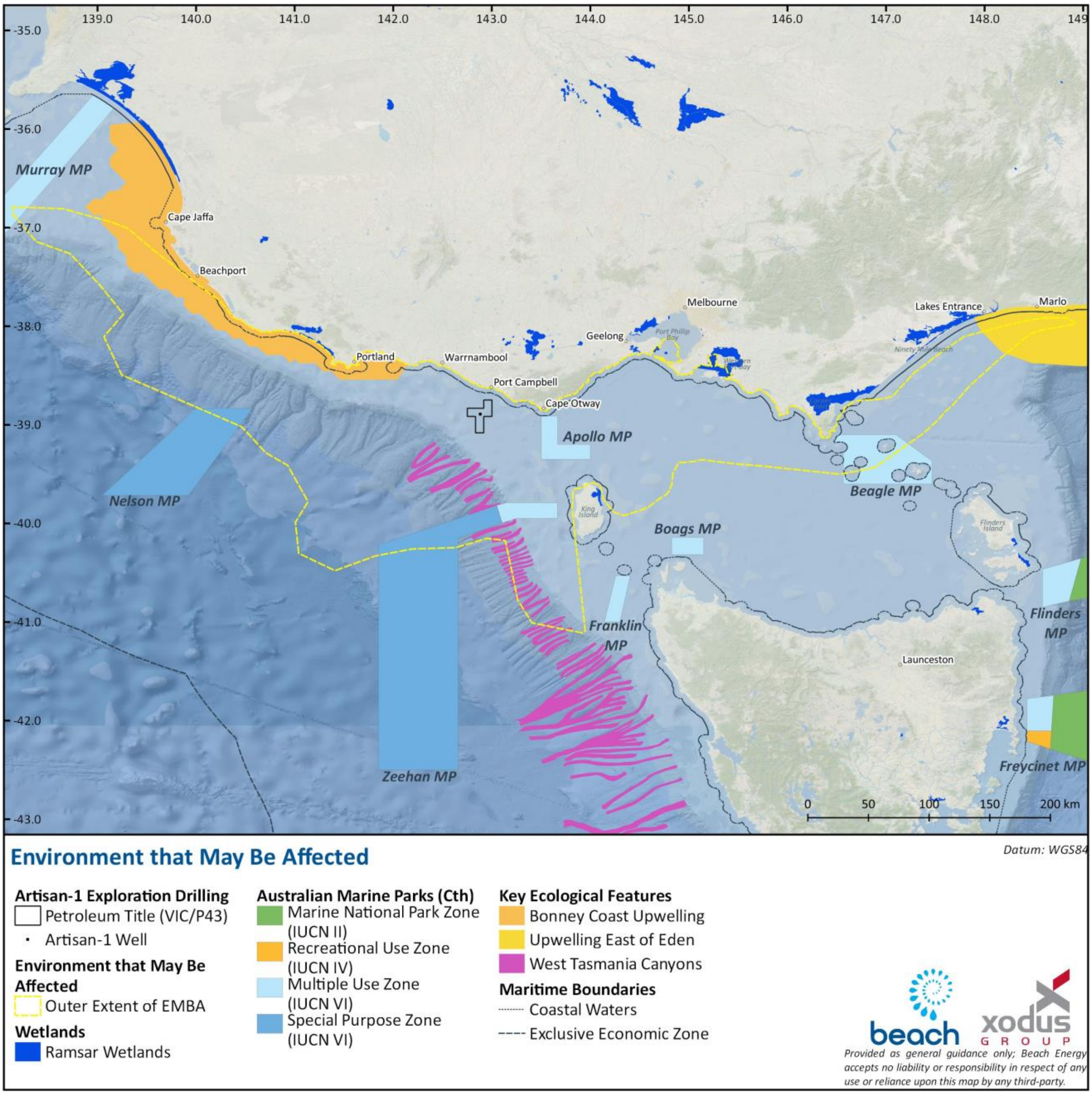


Figure 5-8: Key Ecological Features within the spill EMBA

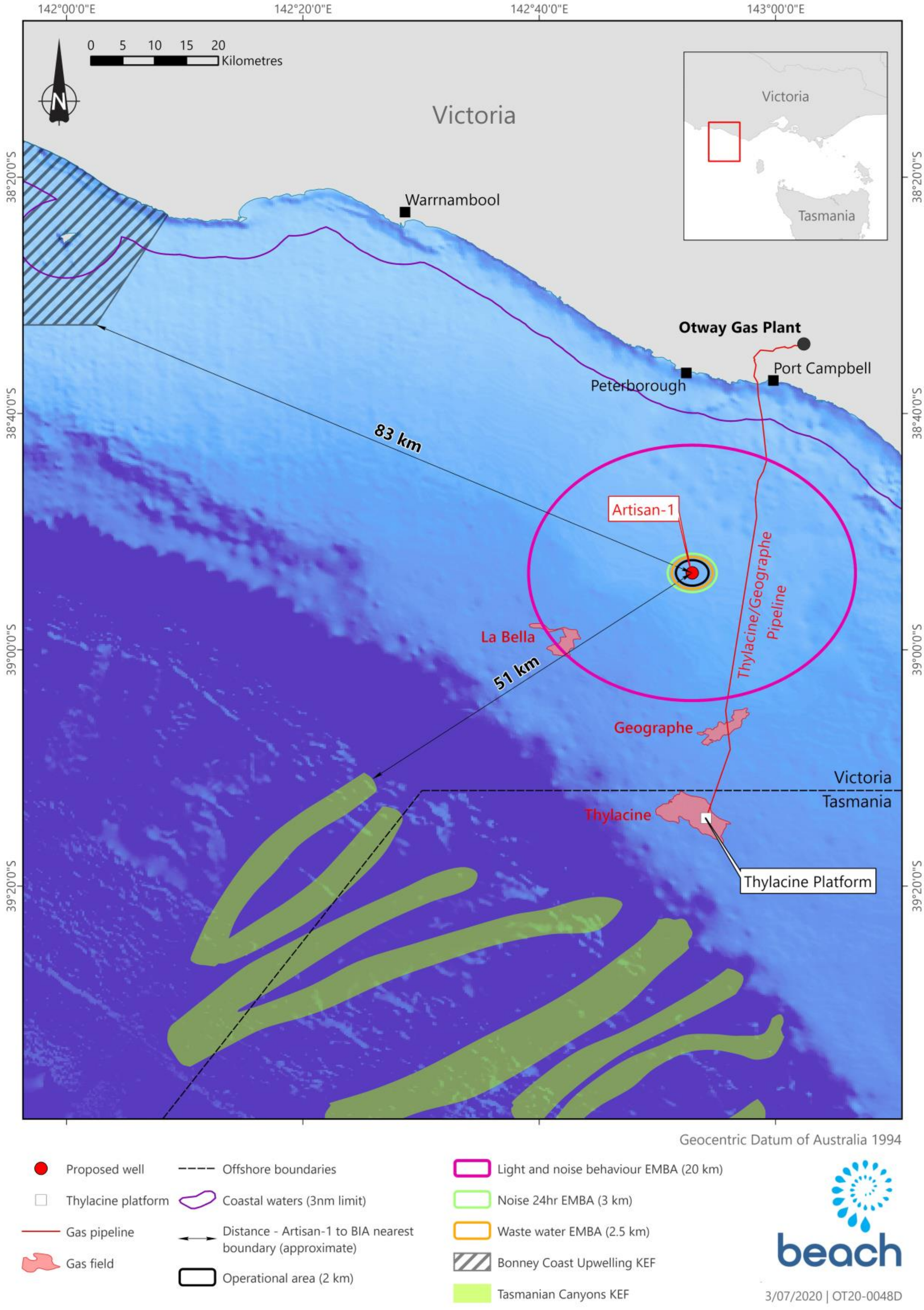


Figure 5-9: Key Ecological Features and operational area, light and noise behaviour, noise 24 hr and waste water EMBAs

5.5.13.1 Bonney Coast Upwelling

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

The Bonney coast upwelling KEF lies on the continental shelf situated ~120 northwest of Cape Jaffa, South Australia to Portland, Victoria (Figure 5-8). The location of the Bonney coast upwelling KEF was originally derived through a review of enhanced chlorophyll occurrence for summer seasonal data between the years of 1998 and 2010 (Research Data Australia 2013).

The Bonney coast upwelling KEF is situated to the west of the operational area and is ~83 km from the Artisan-1 well location.

5.5.13.2 Upwelling East of Eden

The Upwelling east of Eden is valued for having high productivity and aggregations of marine life. In this region, dynamic eddies of the east Australian current cause episodic productivity events when they interact with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms that are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish.

The upwelling supports regionally high primary productivity that supports fisheries and biodiversity, including top order predators, marine mammals and seabirds.

This area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form. The area is also important for seals, other cetaceans, sharks and seabirds.

5.5.13.3 West Tasmanian Canyons

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

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

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

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

5.5.13.4 Shelf Rocky Reefs and Hard Substrates

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

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

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

5.5.13.5 Bass Cascade

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

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

5.6 Physical environment

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

5.6.1 Otway assessments and surveys EMBA

A comprehensive assessment of the coast to continental shelf margin has been undertaken within approximately 4 km^2 of bathymetric data and video footage collected along the pipeline right-of-way options from the Otway Gas Project EIS (Woodside, 2003) (Figure 5-10). These data have been supplemented by numerous benthic sampling events; however, data for this assessment have been referenced primarily from Boreen et al., (1993), and the Otway Gas Project EIS (Woodside, 2003).

In 2002, 2003 and 2004, Fugro undertook a number of bathymetric surveys of the two proposed pipeline rights of way: one constructed for the Thylacine Geographe pipeline and one extending from the completed Geographe A well to Flaxman's Hill (Figure 5-10).

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

The Flaxman's Hill alignment traverses the Thistle drilling area and the Thylacine Geographe pipeline runs parallel and north east of this area. During 2003, bathymetric data was collected, and the right of way was assessed and recorded using an underwater video camera (CEE Consultants Pty Ltd, 2003). Results are summarised in Table 5-5, Table 5-6 and Table 5-7.

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 (Table 5-4: Otway margin geomorphology (Boreen et al., 1993).

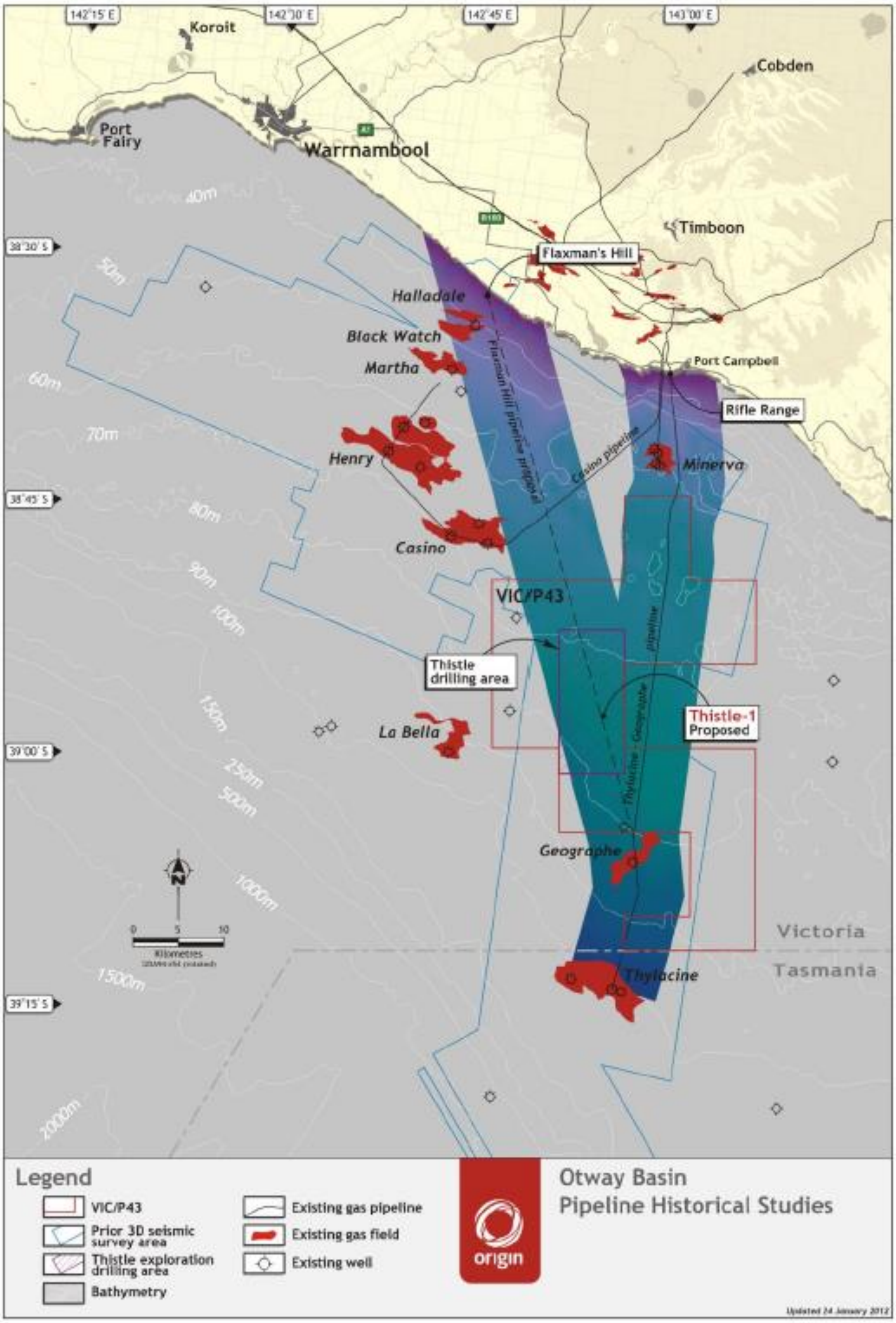


Figure 5-10: Otway Basin previous seabed survey locations

Table 5-4: Otway margin geomorphology (Boreen et al., 1993)

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

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

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

Table 5-6: Geographe to Flaxman's Hill seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

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

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

Depth (m)	Seabed morphology	Benthic assemblage
82		Very low density sessile; large sponge.

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

Table 5-8: Nearshore seabed morphology and benthic assemblages

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

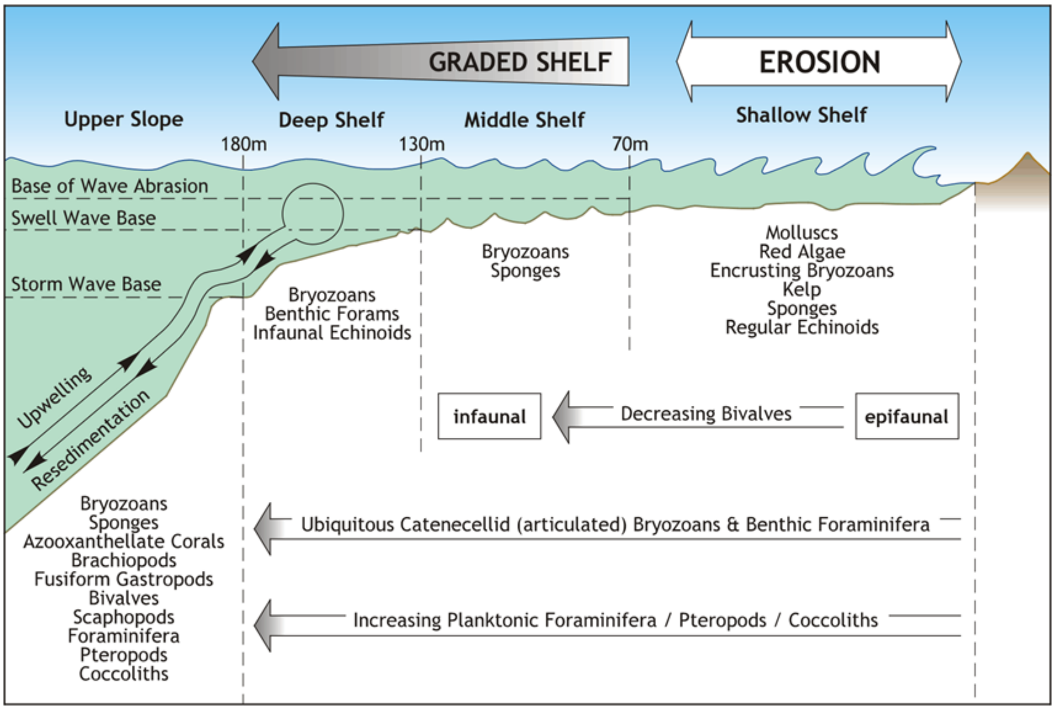


Figure 5-11: Model of the geomorphology of the Otway Shelf

A sampling survey of the surficial sediments, benthic invertebrates and demersal fishes of Bass Strait was undertaken by the Victorian Museum between 1979 and 1983 (Wilson and Poore, 1987) (Table 5-9).

More than 200 sites were sampled with sites 51 through 61, 118, 119, 120, 121, 183, 186 and 192 representatives of the area. Sediments were described in the field from a visual impression or according to the classification of Shepard (Shepard, 1954). 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 (Table 5-9). Data on benthic invertebrates and demersal fishers has not been summarised and published.

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 (BBG, 2003) (Table 5-10).

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 5-10.

Beach commissioned a seabed site assessment for the Otway Gas Development. The seabed site assessment was undertaken from November 2019 to January 2020 and ranged in water depths from 70 to 104 m. The survey extent including the gas fields and infrastructure routes are shown in Figure 5-12.

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. Several different investigation techniques were used to examine and describe the seabed, as well as identify possible hazards from manmade, natural and geological features.

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

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

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

Percent cover ranged from 0 to 80% of the sample photograph for all samples but on average the percent cover was typically no more than 37%. The seabed at Hot Tap X had the greatest average coverage of epibiota while the lowest coverage of epibiota was recorded along the route between Artisan and Hot Tap Y (Figure 5-12. Of the gas field sites, Artisan and Hercules had a slighted greater coverage of epifauna, while the routes between gas fields and Hot Tap Y have the least coverage of epifauna. Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant.

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

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

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

The findings from Ramboll (2020) align with findings from the Otway Gas Project studies (CEE Consultants Pty Ltd, 2003; BBG, 2003) and Boreen et al., (1993) concerning the subsea features and biological communities likely to dominate the EMBA. In summary the seabed of the EMBA can be characterised as a carbonate mid shelf and deeper sections (60 – 70 m) of the shallow shelf with surficial sediments of carbonate rich coarse to medium sands with areas of exposed limestone substrate. The epifauna is dominated by low density, sessile sponge assemblages. Six basalt rises occur in the eastern and south-eastern section of the spill EMBA, the largest of which is the 'Big Reef'.

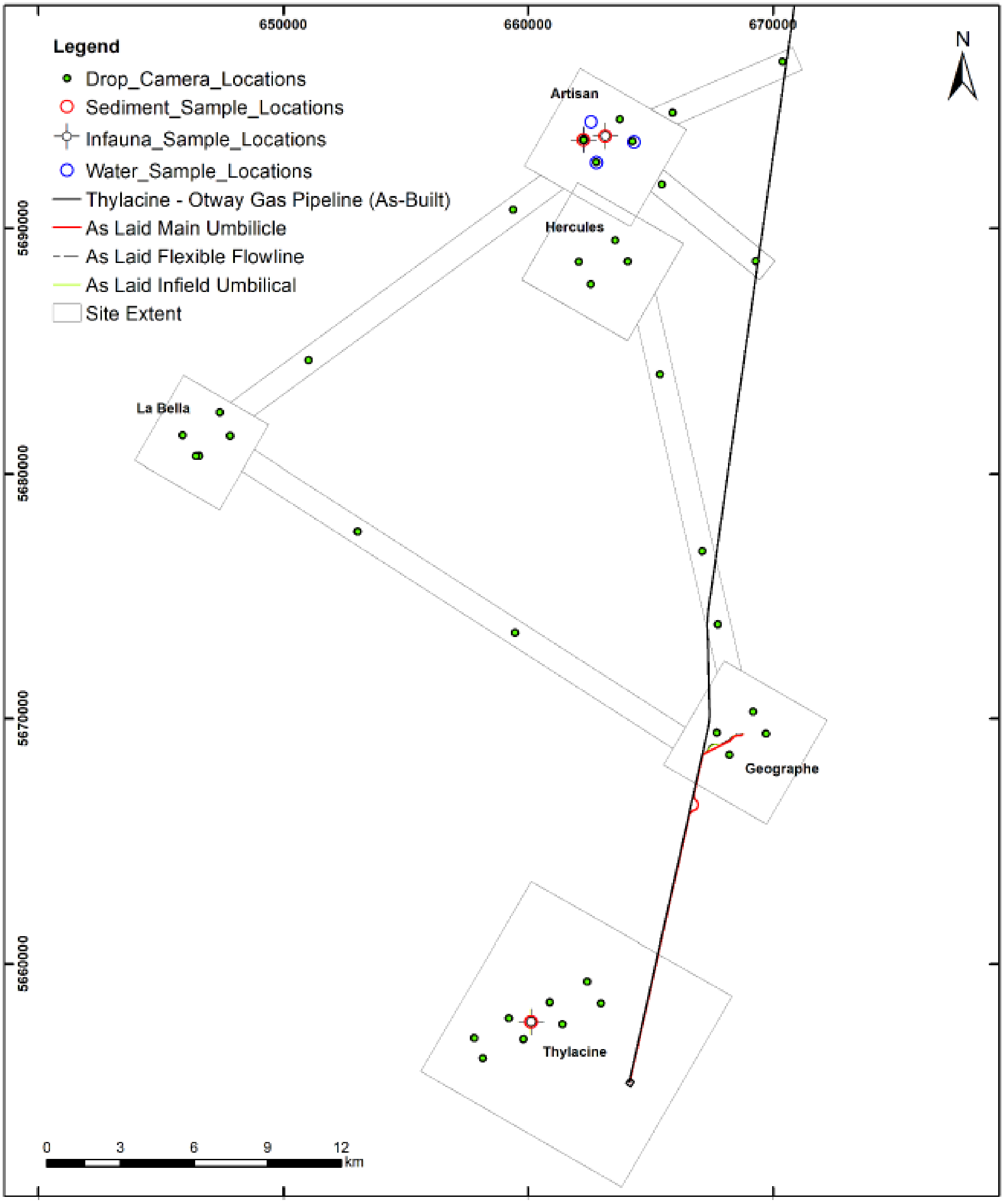


Figure 5-12: Location of the Otway Development seabed site assessment (2019)

5.6.2 Otway assessments and surveys operational area

During October 2019 a seabed survey was undertaken over a 5.0 km by 4.6 km area around the proposed Artisan-1 well location (Fugro, 2019).

The objectives of the seabed survey were to:

- identify potential seabed debris, obstructions and hazards which could interfere with the positioning and anchoring of the MODU.

- identify and map the nature and distribution of geomorphological features types (canyons, scarps, vents, pinnacles etc.) in the operational area.
- identify sub-seabed features and lithology to assist determination of anchor holding capability/limitations.
- accurately measure water depth and map seabed topography across the operational area.
- collect seabed sediment gravity core samples to correlate sub-bottom conditions that may have implications for the MODU anchor holding performance.
- conduct an in-situ cone penetrometer test to suitable depth of interest for anchor holding analysis.
- obtain seabed imagery using a drop camera.
- collect benthic sediment grab samples at the proposed well locations.

The drop camera images are detailed in Figure 5-13 with the location of the images in relation to the Artisan well show in Figure 5-14.

The results to date from the survey identified:

- there is very little bathymetric variation across the survey area with water depths ranging from 67.6 m to 74.3 m. Water depth at the proposed Artisan-1 well location is 70.1 m.
- the seabed topography is dominated by exposed rock on the seabed.
- small patches of very thin transgressive coarse sand are present across the survey area.
- megaripples were seen in some areas, with a wavelength of 1.5 m to 2 m and a height of 0.3 m to 0.5 m.
- the survey area is characterised by low to moderate reflectivity characteristic of rock outcrop.
- a series of elevated mounds were noted in the north-west of the Artisan survey area 0.5 -1.0 m above ambient seabed.
- the seabed showed a scattered sessile biota on a sandy seafloor.
- no rocky reefs or outcrops were identified.

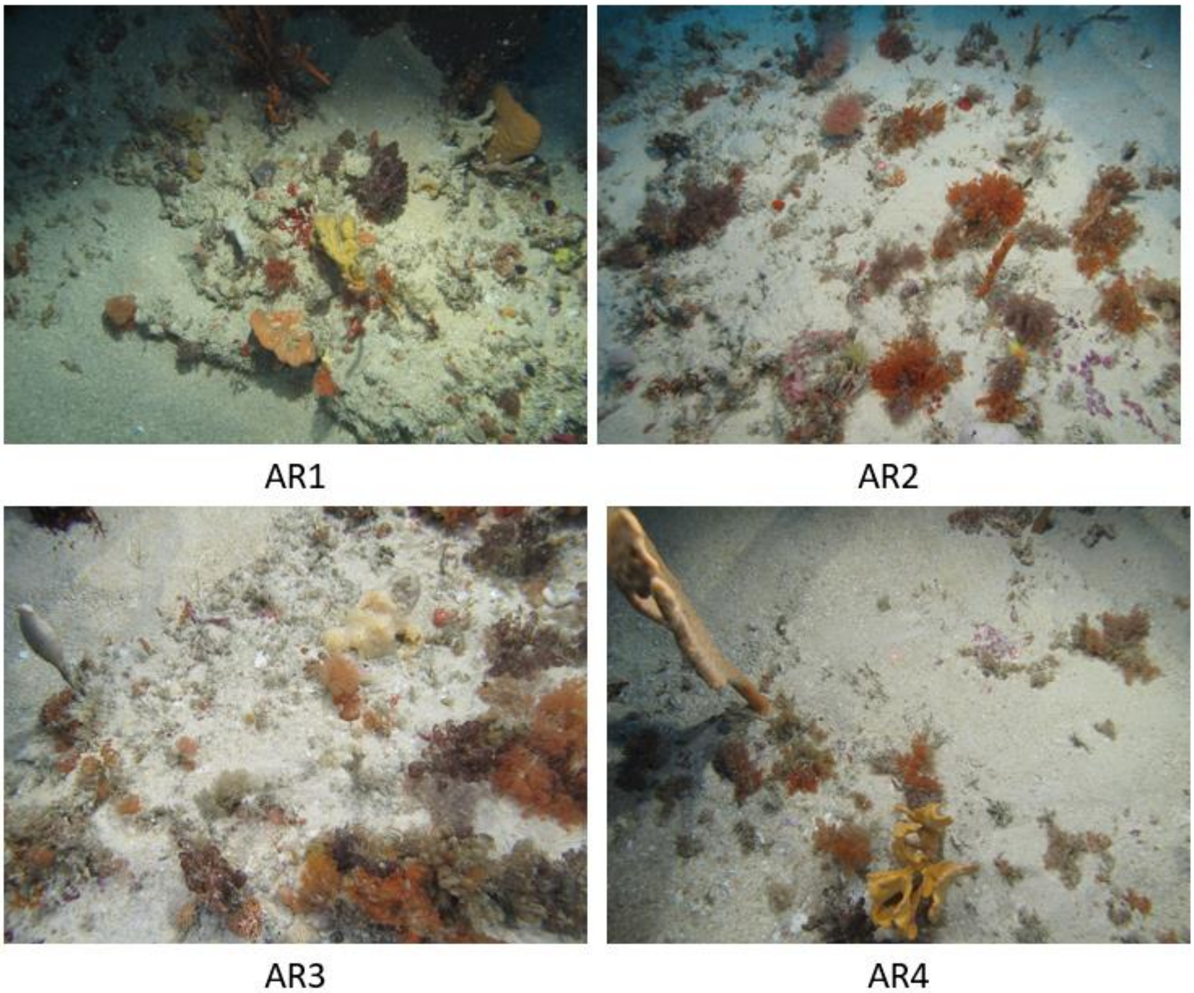


Figure 5-13: Drop camera images at the Artisan well location

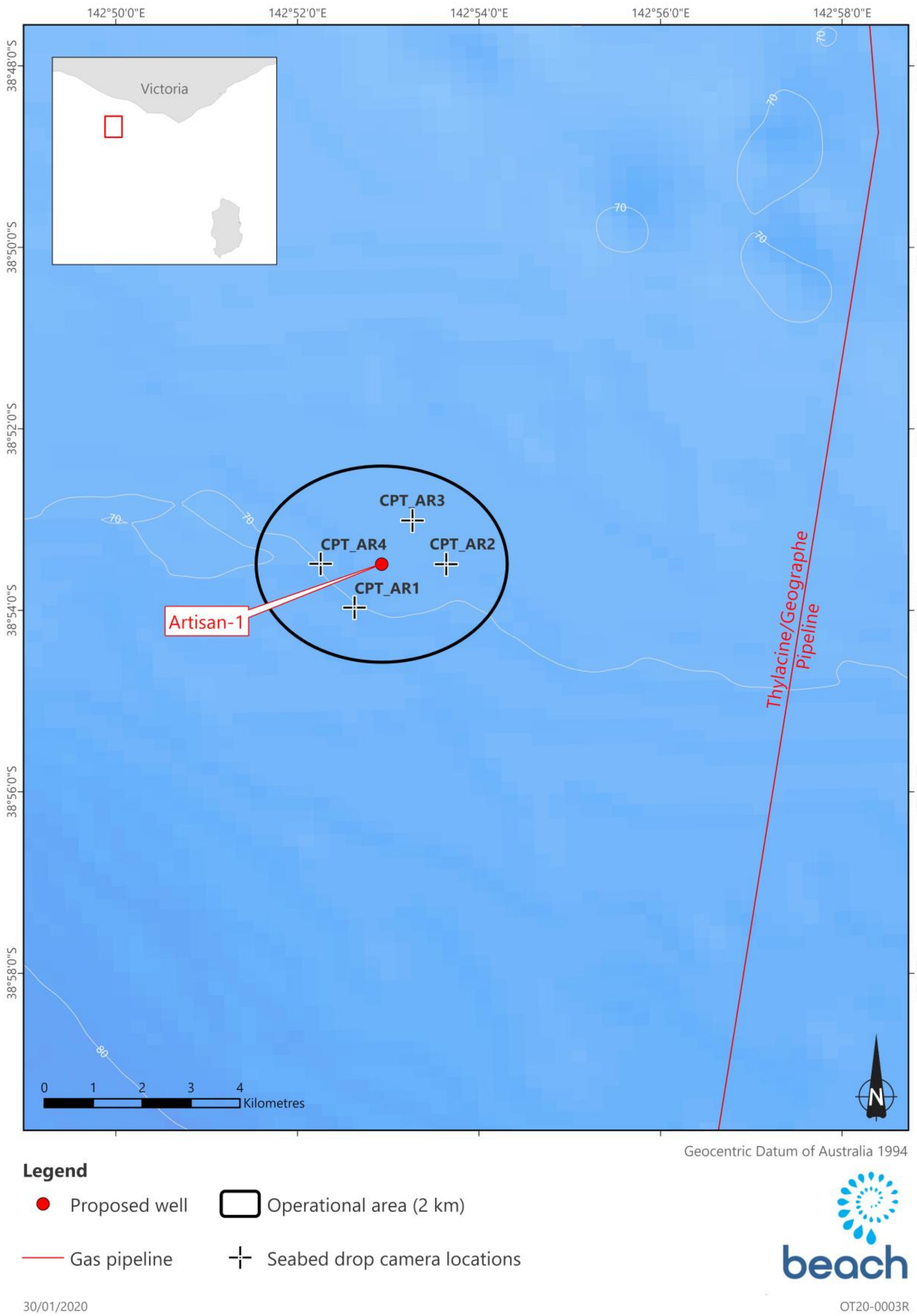


Figure 5-14: Drop camera locations within operational area

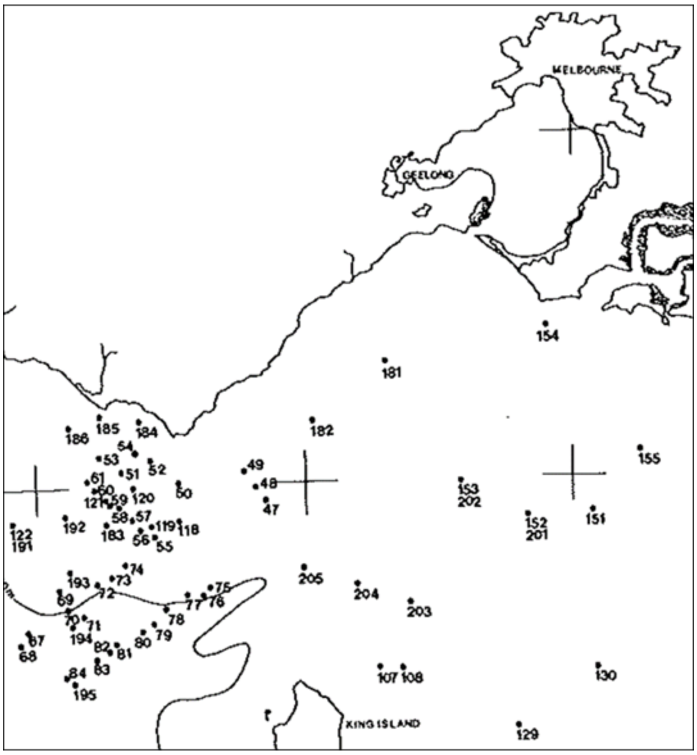


Figure 5-15: Sampling sites for the Bass Straight survey in the region of the spill EMBA (Wilson and Poore, 1987)

Table 5-9: Classification of surficial sediments sampled during the Bass Straight survey in the vicinity of the spill 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

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
192	81	Medium sand	100

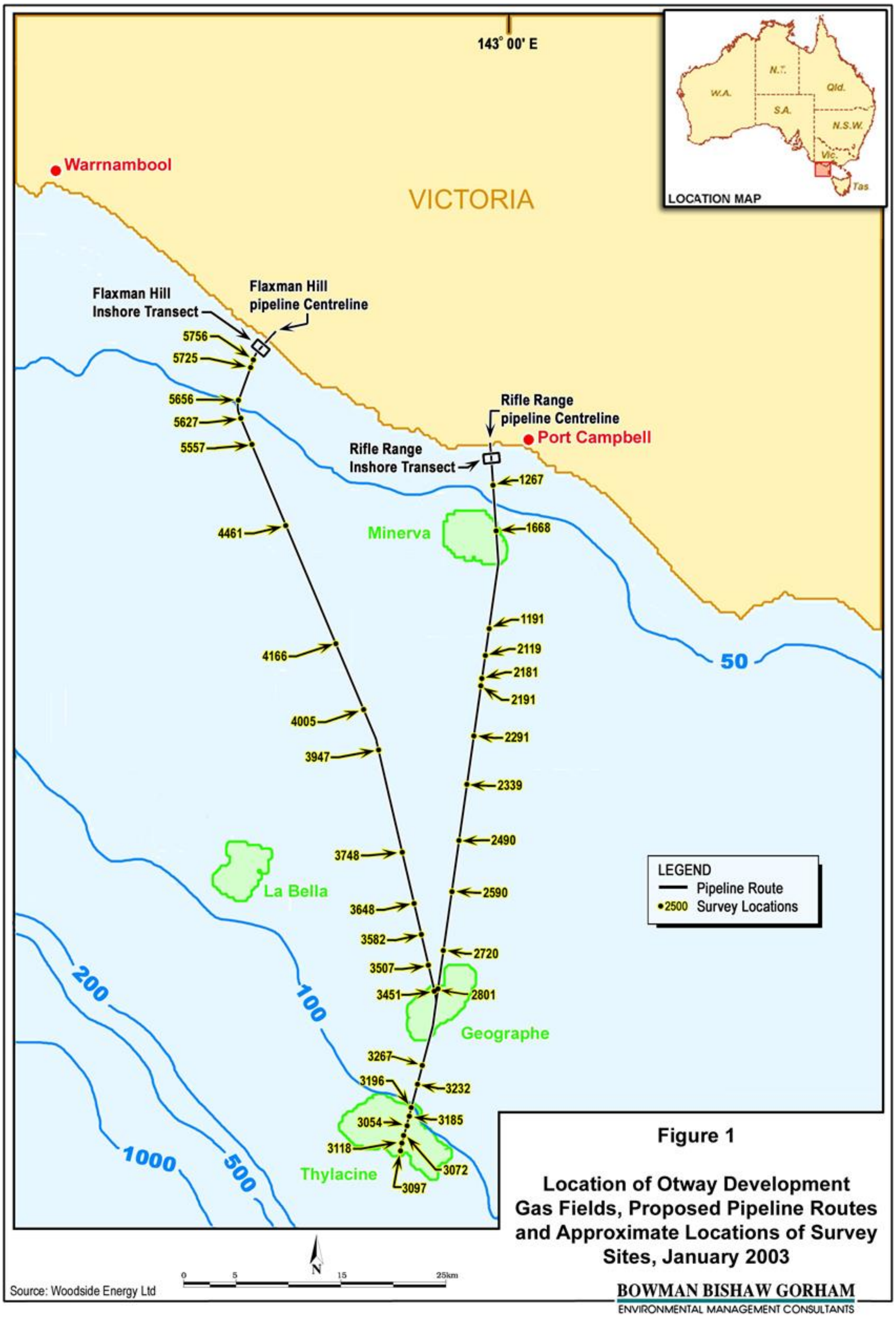


Figure 5-16: Seabed sites assessed by video survey during 2003 (BBG, 2003)

Table 5-10: Seabed characteristics and epifaunal assemblage at video survey sites (BBG, 2003)

Site No.	Depth (m)	Seabed type	Benthic Assemblage
3097	99	Bare rippled sand; minor limestone outcrops	Low density sessile; small sponge dominated
3118	99	Low profile limestone reef with sand veneer; isolated areas of raised l/stone	Low density sessile; sponge dominated
3084	99	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3072	99	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3054	98	Mix of low and high profile l/stone; shallow and deep sand	Low density sessile on low l/stone; high density sessile on high l/stone plus fish; sponge dominated
3185	95	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3196	94	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3232	92	High profile reef stone with deep sand gutters.	Diverse, high density sessile: sponge, coral dominated crinoids common and mobile species
3267	88	Low profile with areas of high profile limestone ridges; incomplete sand veneer.	Diverse, high density sessile: sponge, dominated and mobile species
2801	82	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Very low density sessile; large sponge.
2720	79		Diverse, low – high density sessile
2590	75	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density, sessile: sponge, dominated. Motile: sea urchins dominated
2490	74		Medium density, sessile: sponge, dominated
2339	70		Low - Medium density, sessile: sponge, dominated
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

5.6.3 Metocean conditions

5.6.3.1 Climate

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

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

5.6.3.2 Winds

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

Winds in this section of the Otway basin and western Bass Strait generally exceed 13 knots (23.4 km/h) for 50% of the time. Winds contribute to the predominant moderate to high wave-energy environment of area and are predominantly south-westerly cycling to north-westerly. September is the windiest month, with average wind speeds of 29 km/h (Figure 5-17).

5.6.3.3 Tides

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

5.6.3.4 Ocean currents

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

Ocean currents in Bass Strait are primarily driven by tides, winds and density-driven flows (Figure 5-18). During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Straight. In winter and spring, waters within the straight are well mixed with no obvious stratification, while during summer the central regions of the straight become stratified.

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

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

5.6.3.5 Waves

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

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

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

5.6.3.6 Sea temperature

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

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

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

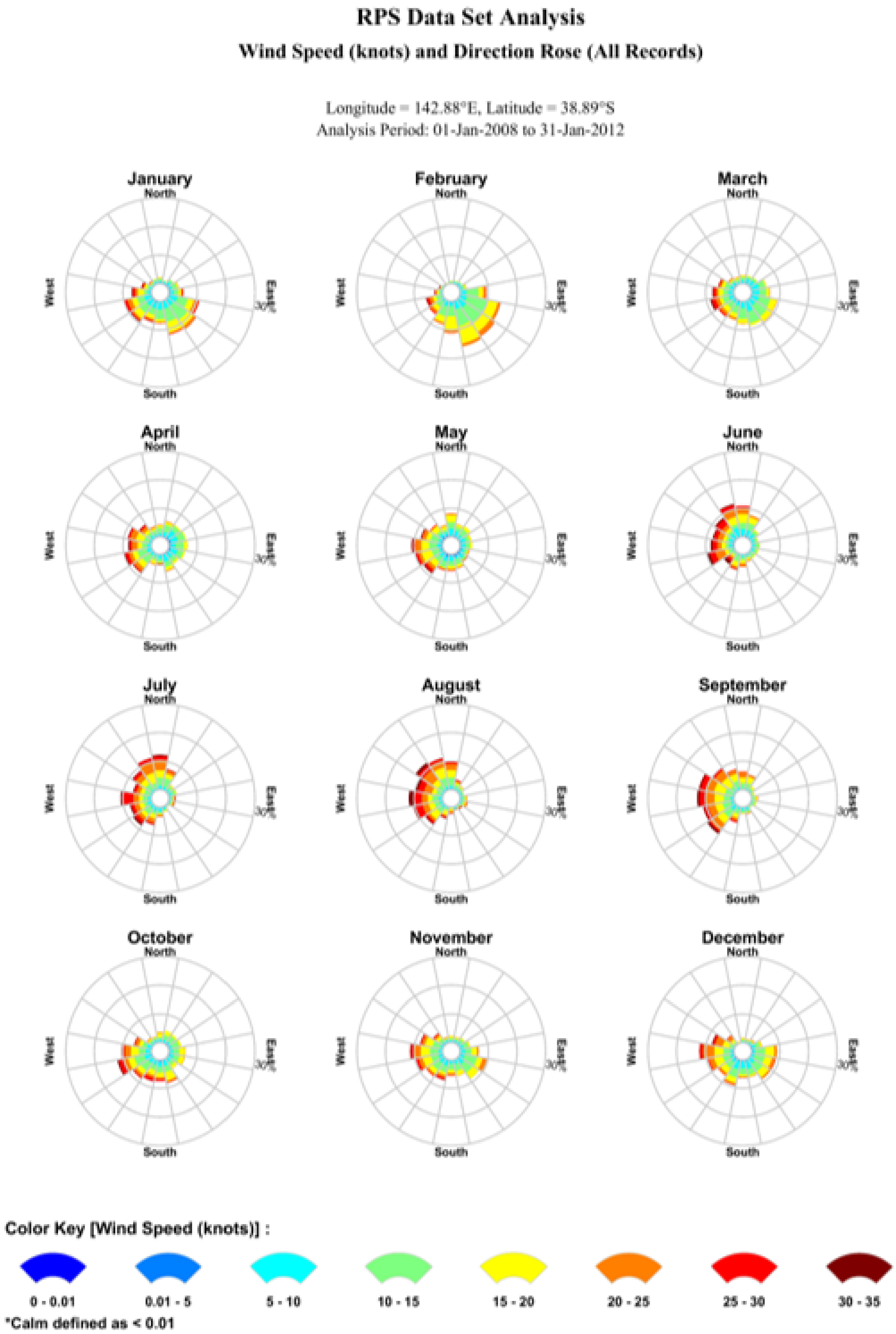


Figure 5-17: Modelled monthly wind rose distributions (RPS, 2019)

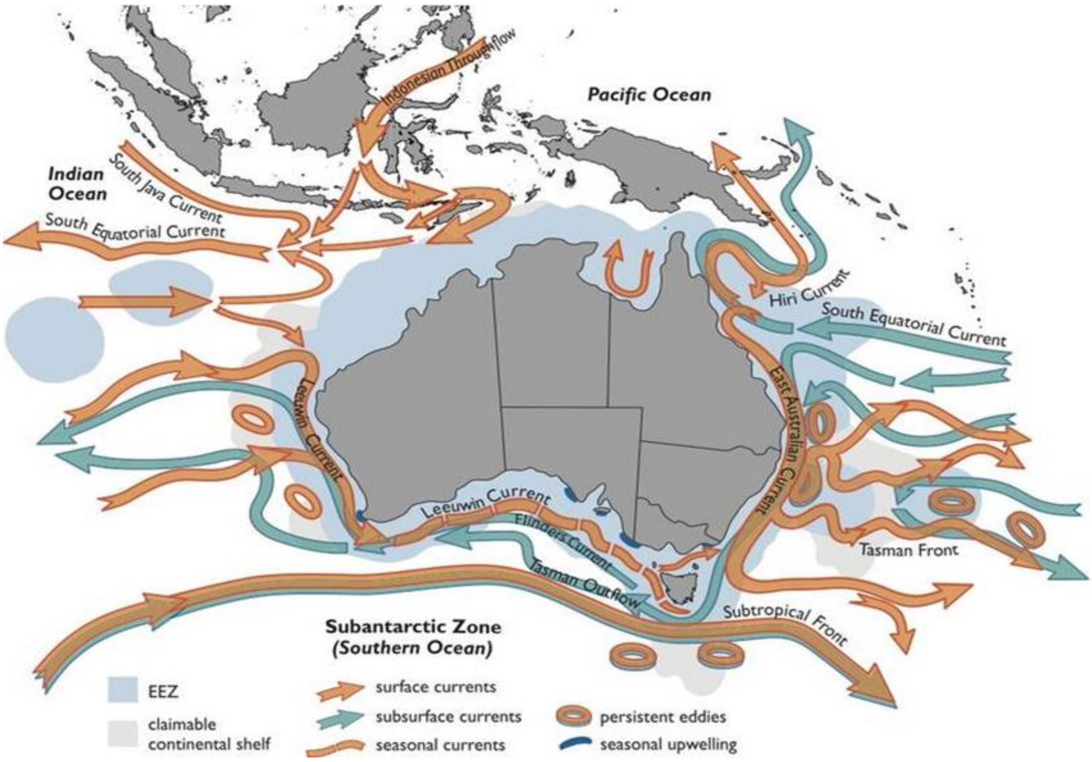


Figure 5-18: Australian ocean currents

5.6.4 Ambient sound levels

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

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

Ambient sound levels in the Otway Basin have been measured as part of impact assessment activities for the petroleum industry. 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 the drill site did not detect drilling noise and recorded ambient noise that ranged between 90 and 110 dB re 1 µPa (McCauley, 2004). Passive acoustic monitoring commissioned by Origin from April 2012 to January 2013, 5 km offshore from the coastline east of Warrnambool, identified that ambient underwater noise in coastal areas are generally higher than further offshore, with a mean of 110 dB re 1 µPa and maximum of 161 dB re 1 µPa (Duncan et al., 2013).

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.

5.6.5 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 coast upwelling) around the continental shelf margin (Origin, 2015). Significant upwelling of colder, nutrient rich deep water during summer can cause sea surface temperatures to decrease by 3°C compared with offshore waters (Butler et al., 2002).

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

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020. Appendix E). Water samples were collected at the Artisan field.

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

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. 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 Thylacine_1_2 water sample but were at levels of no concern. TRHs were below detection limits in all other samples. The level of chlorophyll a in filtered samples was below the detection level.

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

It is expected that water quality within the operational area and all EMBAs (light and noise behaviour, noise 24 hr, waste water and spill) will be typical of the offshore marine environment of the Otway Basin, which is characterised by high water quality with low background concentrations of trace metals and organic chemicals.

5.6.6 Sediment quality

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020. Appendix E). Sediment samples were collected at two of the gas fields, Artisan and Thylacine using a Double Van Veen grab sampler. 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 ORP (oxidation-reduction potential) 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 LOR or at levels of no concern.

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

It is expected that sediment quality within the operational area, light, noise, waste water or spill EMBAs will be typical of the offshore marine environment of the Otway Basin.

5.6.7 Air quality

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

The Victorian air quality data is collected at 15 performance monitoring stations representing predominantly urban and industrial environments in the Port Phillip and Latrobe Valley regions of Victoria. Results are assessed against the requirements of the National Environment Protection (Ambient Air Quality) Measure for the pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), particles less than 10 micrometres in diameter (PM10) and particles less than 2.5 micrometres in diameter (PM2.5). The most recent annual air monitoring report shows Victoria's air quality in 2015 was generally good with AAQ NEPM 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 Artisan-1 well location; however, it is situated in an urban environment and is not representative of the clean air environment over the majority of the EMBAs. The Cape Grim Baseline Air Pollution Station data is likely a more reliable point of reference for air quality in the EMBAs as the air sampled arrives at Cape Grim after long trajectories over the Southern Ocean and is representative of a large area unaffected by regional pollution sources (cities or industry) (CSIRO, 2017). The Cape Grim station monitors greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and synthetic GHGs such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

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

5.6.8 Bonney coast upwelling

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

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

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

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

Variability

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

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

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

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

Ecological importance

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

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

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

Linkages between climate, upwelling strength and blue whale abundance

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

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

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

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

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

Operational Setting

Mapping of the Bonney coast upwelling frequency by Huang and Wang (2019) identified that the occurrence of an upwelling event between 2002 and 2016 (measured by remote sensing of a combination of SST anomaly and chlorophyll-a) within the operational area was unlikely with an upwelling frequency for this area of <10%. The closest areas of increased frequency of upwelling events to the operational area (10-30% occasional/semi-seasonal) were small isolated areas situated in coastal areas (Figure 5-19

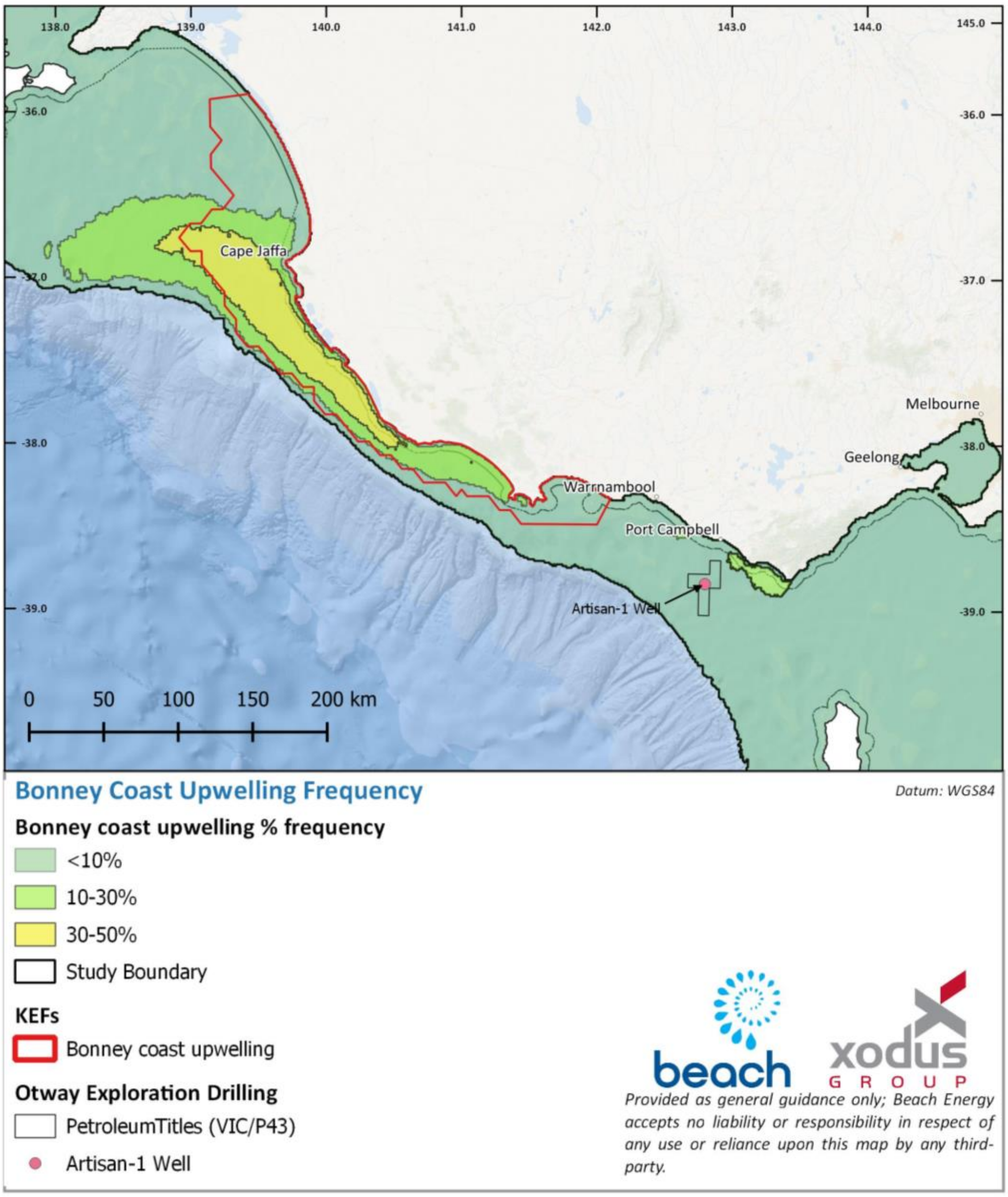


Figure 5-19 Bonney coast upwelling frequency (*Source: Huang and Wang 2019, Geoscience Australia 2020*)

) ~18 km from the operational area. Small areas (1 km^2) of further increased frequencies of Bonney coast upwellings (30-50% seasonal) were found to the west ~175 km from the operational area with significant increased frequencies ~220 km away.

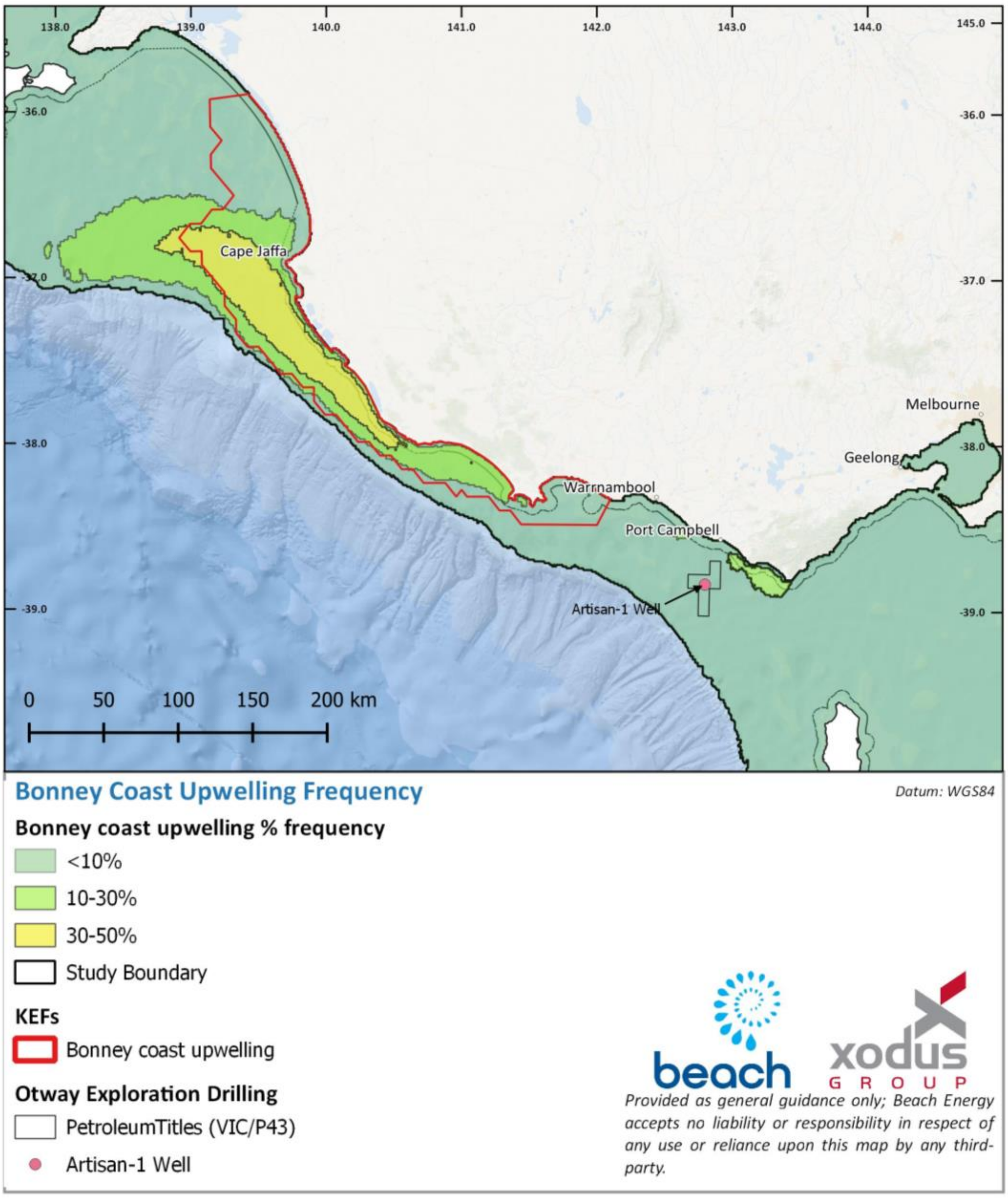


Figure 5-19 Bonney coast upwelling frequency (*Source: Huang and Wang 2019, Geoscience Australia 2020*)

5.7 Ecological environment

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

- online government databases, publications, and interactive mapping tools, such as the SPRAT database.
- the PMST for Matters of National Environmental Significance (MNES) protected under the EPBC Act.
- published observations, data and statistics on marine mammals.
- reports from scientific experts and institutions, marine biologist and experts in blue whale and southern right whale populations in the Otway area.

- Woodside's Otway Gas Project Environmental Effects Statement/Environmental Impact Assessment (EES/EIS) (2003) (Woodside, 2003).
- Santos Casino Gas Field Development Environmental Report (2004) (Santos, 2004).
- BHP Billiton's Minerva Environmental Impact Statement and Environmental Effects Statement and Associated Supplemental Environmental Monitoring published research papers (BHP Billiton, 1999).
- Origin Energy's Environment Plans for previous activities in the region.
- the National Conservation Values Atlas (Commonwealth of Australia, 2015).
- relevant listings under the Victorian FFG Act 1988 (DELWP, 2017b)
- relevant listings under the Tasmanian Threatened Species Conservation Act (1995) (TSC Act)
- relevant environmental guidelines and publicly available scientific literature on individual species.

5.7.1 Benthic habitats and species assemblages

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

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

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

The dominant benthic habitat throughout the area, as indicated by the sampling and video studies outlined in Section 5.7.1 is medium to coarse carbonate sands with areas of low relief exposed limestone. A series of basaltic rises occur in the south eastern corner of the spill EMBA. The benthic species assemblages known or likely to be associated with these habitats are described in the following sections.

5.7.1.1 Soft Sediment

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

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

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

5.7.1.2 Seagrass

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

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

Within the spill EMBA seagrass is present along the South Australian (SA) and Victorian coastline (Figure 5-20).

5.7.1.3 Algae

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

Macroalgae communities occur throughout the Australian coast and are generally found on intertidal and shallow subtidal rocky substrates. Macroalgal systems are an important source of food and shelter for many ocean species; including in their unattached drift or wrack forms (McClatchie *et al.*, 2006). Macroalgae are divided into three groups: Phaeophyceae (brown algae), Rhodophyta (red algae), and Chlorophyta (green algae). Brown algae are typically the most visually dominant and form canopy layers (McClatchie *et al.*, 2006). The presence and growth of macroalgae are affected by the principal physical factors of temperature, nutrients, water motion, light, salinity, substratum, sedimentation and pollution (Sanderson, 1997). Macroalgae assemblages vary, but *Ecklonia radiata* and *Sargassum* sp. are typically common in deeper areas. Within the spill EMBA macroalgae is present along the South Australian (SA) and Victorian coastline from Beachport in SA to Philip Island (Figure 5-21).

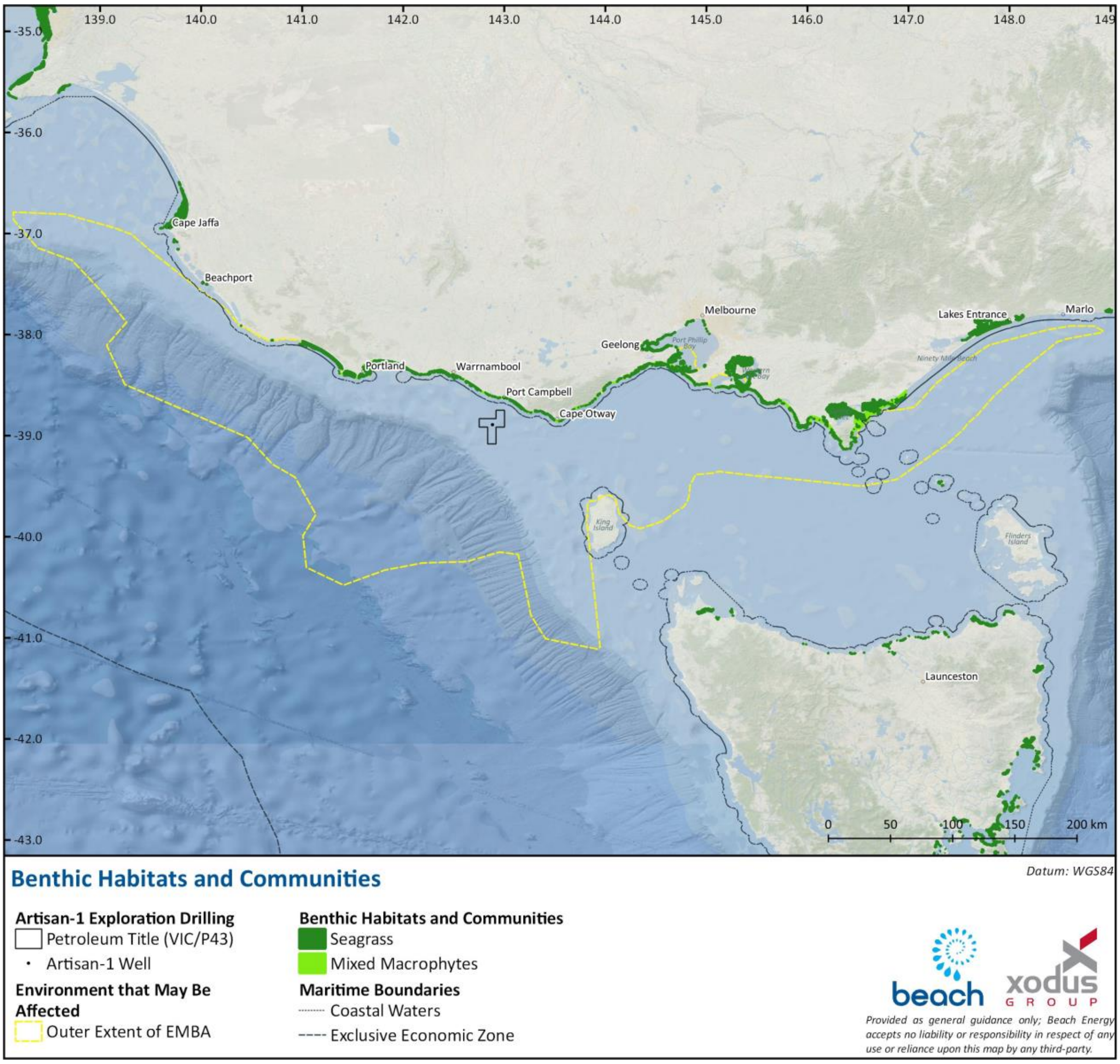


Figure 5-20: Presence of seagrass (and mixed macrophyte) habitat within the spill EMBA

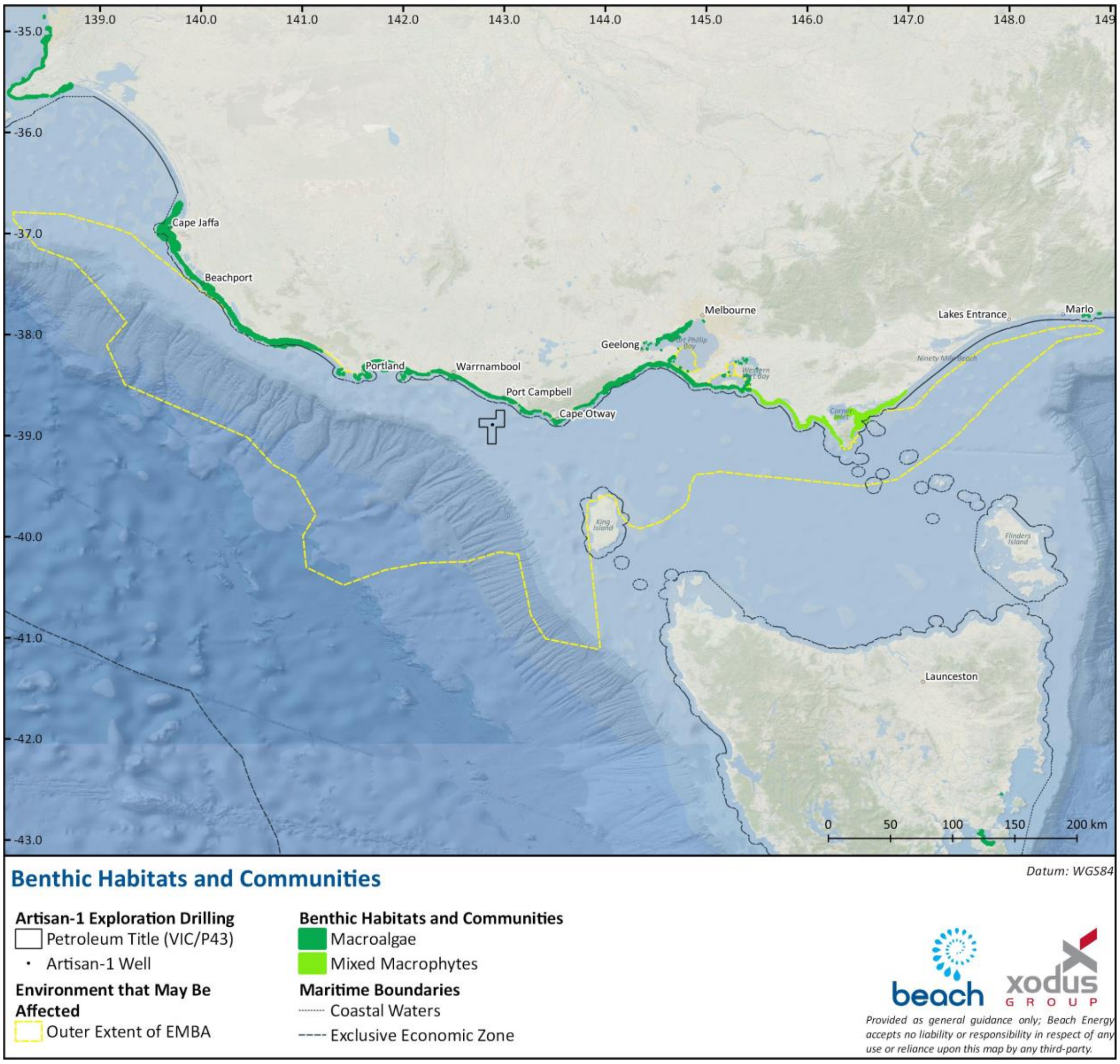


Figure 5-21: Presence of macroalgae (and mixed macrophyte) habitat within the spill EMBA

5.7.1.4 Coral

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

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

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

5.7.1.5 Carbonate sands and exposed limestone

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

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

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

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

5.7.1.6 Basalt rises

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

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

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

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

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

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

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

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

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

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

5.7.2 Mangroves

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

The mangroves in Victoria are the most southerly extent of mangroves found in the world and are located mostly along sheltered sections of the coast within inlets or bays (MESA, 2015). There is only one species of mangrove found in Victoria, the white or grey mangrove (*Avicennia marina*), which is known to occur at Western Port and Corner Inlet within the spill EMBA (Figure 5-22).

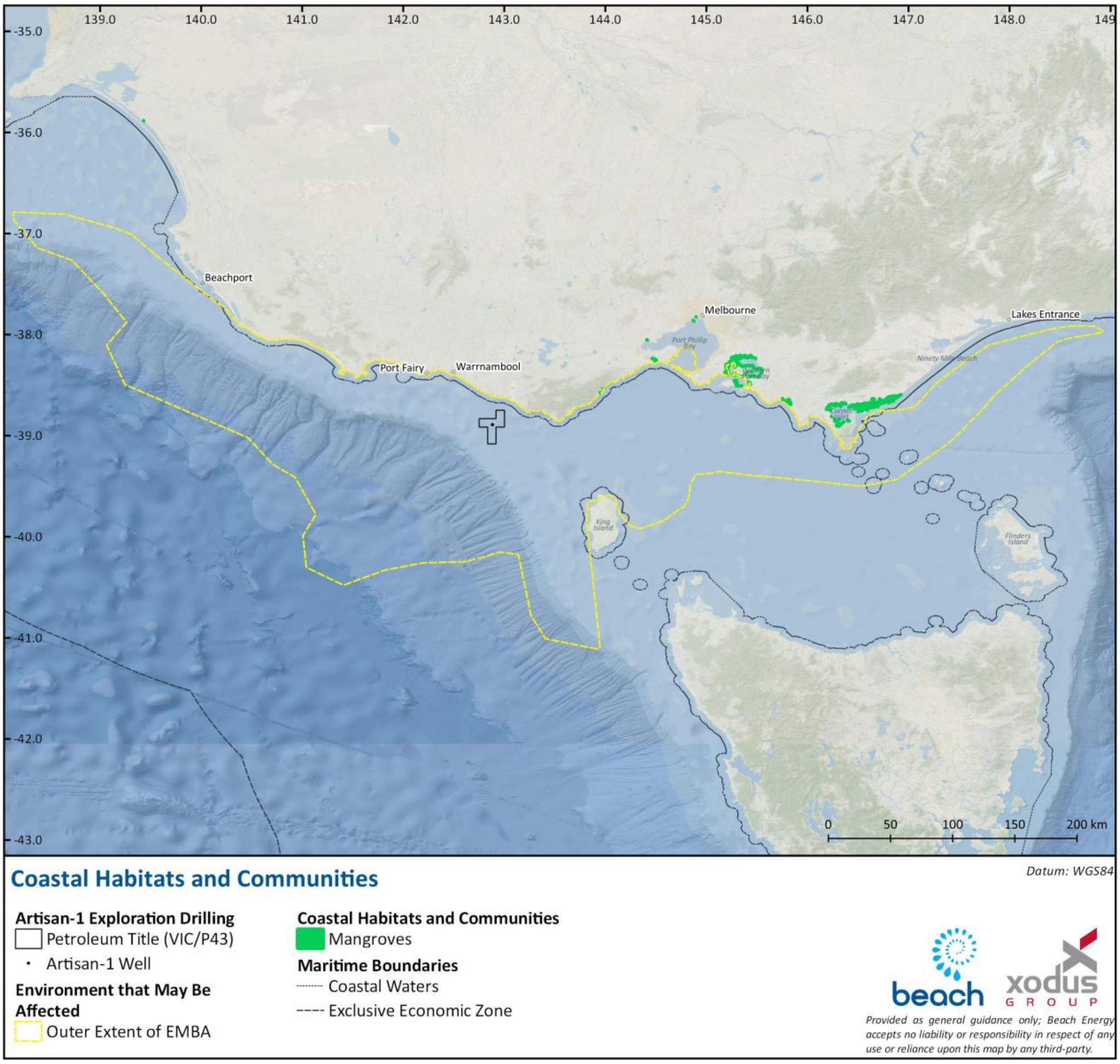


Figure 5-22: Presence of mangrove habitat within the spill EMBA

5.7.3 Saltmarsh

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

Saltmarsh is found along many parts of the Victorian coast, although is most extensive in western Port Phillip Bay, northern Western Port, within the Corner Inlet-Nooramunga complex, and behind the sand dunes of Ninety Mile Beach in Gippsland (Figure 5-23) (Boon et al., 2011).

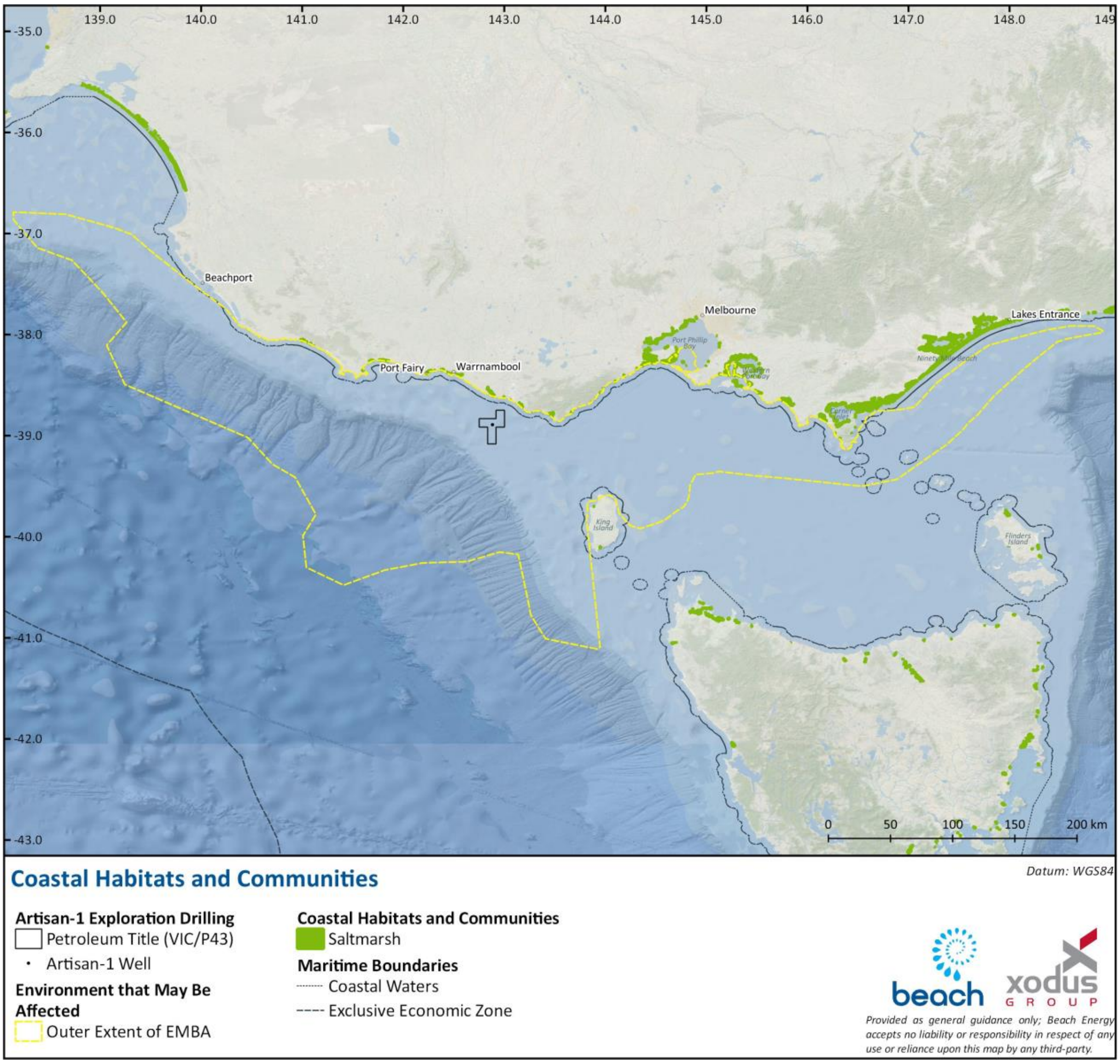


Figure 5-23: Presence of saltmarsh habitat within the spill EMBA

5.7.4 Plankton

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

The carrying capacity of marine ecosystems (the mass of fish resources) and recruitment of individual stocks is strongly related to plankton abundance, timing and composition. In the spill EMBA, the seasonal Bonney coast upwelling is a productivity hotspot, with high densities of zooplankton and are important for fish and whales. Of 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 EMBAs 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.

5.7.5 Invertebrates

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

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

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

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

5.7.6 Threatened ecological communities

Threatened Ecological Communities (TECs) provide wildlife corridors or refugia for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species). The spill EMBA PMST Report (Appendix A.1) identified the following TECs:

- assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community
- giant kelp marine forests of South East Australia
- grassy eucalypt woodland of the Victorian Volcanic Plain
- natural damp grassland of the Victorian Coastal Plains
- natural temperate grassland of the Victorian Volcanic Plain
- subtropical and temperate coastal saltmarsh
- white box-yellow box-Blakely's red gum grassy woodland and derived native grassland.

Of the TECs listed above, only the assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community, the giant kelp marine forests of South East Australia and the subtropical and temperate coastal saltmarsh vulnerable community have potential to be impacted by an oil spill associated with the development, as the rest are terrestrial listings (Figure 5-24).

No TECs were identified in the operational area, light and noise behaviour, noise 24 hr or waste water EMBAs.

Note that the spill EMBA PMST was conducted with a 1 km buffer and therefore may encroach on land and include terrestrial TECs. The spill scenario for gas condensate may impact shoreline but will be limited to a few metres from the high water mark.

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

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

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

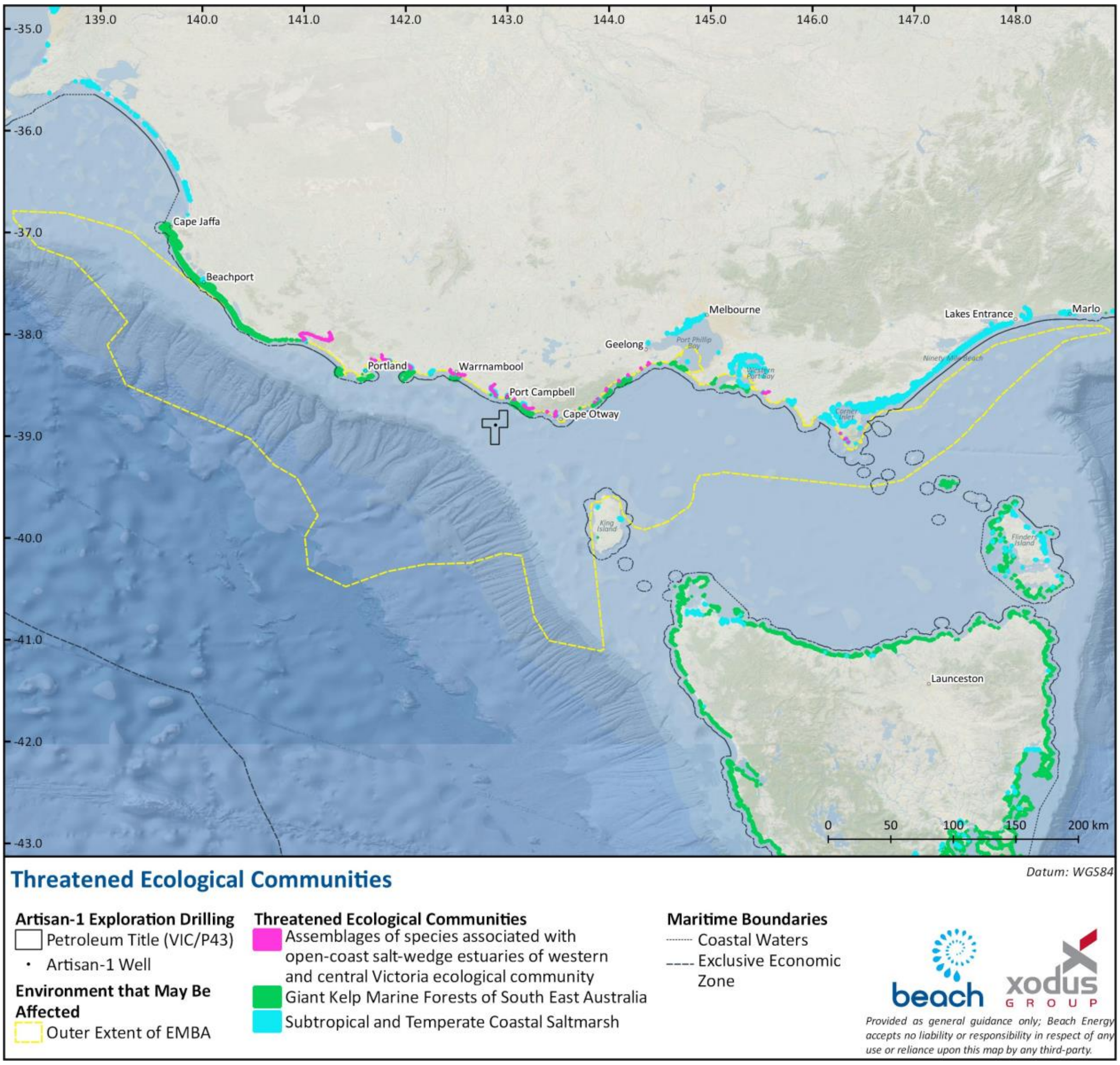


Figure 5-24: Threatened ecological communities within the spill EMBA

5.7.6.2 Giant Kelp Marine Forests of South East Australia

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

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

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

Figure 5-24 shows that the largest extent of giant kelp marine forests are along the SA coastline with patches around the Victorian coastline.

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

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

5.7.6.3 Subtropical and Temperate Coastal Saltmarsh

The Subtropical and Temperate Coastal Saltmarsh TEC occurs in a relatively narrow strip along the Australian coast, within the boundary along 23°37' latitude along the east coast and south from Shark Bay on the west coast (Threatened Species Scientific Committee, 2013). The community is found in coastal areas which have an intermittent or regular tidal influence. Figure 5-24 shows that from Corner Inlet to Marlo there is a substantial amount of subtropical and temperate coastal saltmarsh along the Victorian coastline.

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

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

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

5.7.7 Threatened and Migratory species

PMST reports were generated for the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs to identify the listed Threatened and Migratory species that may be present in these area (Appendix A.1 – A.5). The spill EMBA encompasses the smaller operational area, light and noise behaviour, noise 24 hr and waste water EMBAs.

A total of 104 Threatened species and 76 Migratory species were identified as potentially occurring within the broader spill EMBA. There were also 129 marine species and 30 cetaceans identified as potentially occurring within the spill EMBA.

5.7.7.1 Marine Fauna of Conservation Significance

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

- threatened (further divided into categories; extinct, extinct in the wild, critically endangered, endangered, vulnerable, conservation-dependent)
- migratory
- whale or other cetaceans
- marine.

Details of listed fauna and their likely presence in the operational area and EMBAs (light and noise behaviour, noise 24 hr, waste water and spill) are provided in the following sections.

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

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

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

There is no habitat critical to the survival of listed species within the operational area or EMBAs. BIAs within the operational area and EMBAs are summarised in Table 5-11 with further details in the relevant species sections.

Table 5-11: BIAs identified within the operational area, waste water, noise 24 hr, light and noise behaviour and spill EMBAs

Receptor	Operational area (2 km)	Waste water EMBA (2.5 km)	Noise 24 hr EMBA (3 km)	Light and noise behaviour EMBA (20 km)	Spill EMBA	Type of BIA
Birds						
Antipodean albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Australasian gannet	83 km	82.5 km	81.5 km	65 km	Overlap	Foraging
Black-browed albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Black-faced Cormorant	106 km	105.5 km	104.5 km	88 km	Overlap	Foraging,
	> 106 km	> 105.5 km	> 104.5 km	> 88 km	Overlap	Breeding,
Buller's albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Campbell albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Common diving-petrel	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
	91 km	90.5 km	89.5 km	73 km	Overlap	Breeding
Indian yellow-nosed albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Little penguin	108 km	107.5 km	106.5 km	90 km	Overlap	Foraging
	> 108 km	> 107.5 km	> 106.5 km	> 90 km	Overlap	Breeding
Shy albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Short-tailed shearwater	11 km	10.5 km	9.5 km	Overlap	Overlap	Foraging
	116 km	115.5 km	114.5 km	98 km	Overlap	Breeding
Wandering albatross	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging
Wedge-tailed shearwater	Overlap	Overlap	Overlap	Overlap	Overlap	Breeding, Foraging
White-faced storm petrel	61 km	60.5 km	59.5 km	43 km	Overlap	Foraging

Receptor	Operational area (2 km)	Waste water EMBA (2.5 km)	Noise 24 hr EMBA (3 km)	Light and noise behaviour EMBA (20 km)	Spill EMBA	Type of BIA
Fish						
Great white shark	Overlap	Overlap	Overlap	Overlap	Overlap	Distribution
Pinnipeds						
Australian sea lion	>200 km	>200 km	>200 km	>200 km	Overlap	Foraging
Cetaceans						
Southern right whale	32 km	31.5 km	30.5 km	14 km	Overlap	Aggregation
	25 km	24.5 km	23.5 km	7 km	Overlap	Migration
	Overlap	Overlap	Overlap	Overlap	Overlap	Distribution
	115 km	114.5 km	113.5 km	97 km	Overlap	Connecting habitat
Pygmy blue whale	Overlap	Overlap	Overlap	Overlap	Overlap	Foraging

5.7.7.3 Fish

Fish species present in the operational area or EMBAs are either pelagic (living in the water column), or demersal (benthic). Fish species inhabiting the region are largely cool temperate species, common within the SEMR. The spill EMBA PMST report (Appendix A.1) identified 30 listed fish species that potentially occur in the spill EMBA. Table 5-12 details the listed fish species identified in the spill EMBA PMST report.

The following fish species were identified in the operational area, light and noise behaviour, noise 24 hr and waste water EMBA PMST Reports (Appendix A.2 to A.5):

- Australian grayling: light and noise behaviour EMBA and noise 24 hr EMBA.
- White shark: operational area, light and noise behaviour, EMBA, noise24 hr EMBA and waste water EMBA
- Shortfin mako: operational area, light and noise behaviour EMBA, noise24 hr EMBA and waste water EMBA
- Porbeagle, mackerel shark: operational area, light and noise behaviour EMBA, noise 24 hr EMBA and waste water EMBA
- Pipefish, seahorse, seadragons: operational area, light and noise behaviour EMBA, noise 24 hr EMBA and waste water EMBA

Table 5-12: Listed fish species identified in the PMST report

Common name	Species name	EPBC Act status			Likely presence	BIA
		Listed Threatened	Listed Migratory	Listed marine		
Fish						
Australian grayling	*Prototroctes maraena*	V	-	-	SHK	
Whale shark	*Rhincodon typus*	V	M	-	SHM	
Sharks and rays						
White shark	*Carcharodon carcharias*	V	M	-	BK	Distribution
Shortfin mako	*Isurus oxyrinchus*	-	M	-	SHL	
Porbeagle, mackerel shark	*Lamna nasus*	-	M	-	SHL	
Pipefish, seahorse, seadragons						
Southern pygmy pipehorse	*Acentronura austral*	-	-	L	SHM	
Tryon's pipefish	*Campichthys tryoni*	-	-	L	SHM	
Upside-down pipefish	*Heraldia nocturna*	-	-	L	SHM	
Bigbelly seahorse	*Hippocampus abdominalis*	-	-	L	SHM	

Common name	Species name	EPBC Act status			Likely presence	BIA
		Listed Threatened	Listed Migratory	Listed marine		
Short-head seahorse	*Hippocampus breviceps*	-	-	L	SHM	
Bullneck Seahorse	*Hippocampus minotaur*	-	-	L	SHM	
Briggs' crested pipefish	*Histiogamphelus briggsii*	-	-	L	SHM	
Rhino pipefish	*Histiogamphelus cristatus*	-	-	L	SHM	
Knife-snouted pipefish	*Hypselognathus rostratus*	-	-	L	SHM	
Deep-bodied pipefish	*Kaupus costatus*	-	-	L	SHM	
Trawl pipefish	*Kimblaeus bassensis*	-	-	L	SHM	
Brushtail pipefish	*Leptoichthys fistularius*	-	-	L	SHM	
Australian smooth pipefish	*Lissocampus caudalis*	-	-	L	SHM	
Javelin pipefish	*Lissocampus runa*	-	-	L	SHM	
Sawtooth pipefish	*Maroubra perserrata*	-	-	L	SHM	
Mollison's pipefish	*Mitotichthys mollisoni*	-	-	L	SHM	
Half-banded pipefish	*Mitotichthys semistriatus*	-	-	L	SHM	
Tucker's pipefish	*Mitotichthys tuckeri*	-	-	L	SHM	
Red pipefish	*Notiocampus ruber*	-	-	L	SHM	
Leafy seadragon	*Phycodurus eques*	-	-	L	SHM	
Common seadragon	*Phyllopteryx taeniolatus*	-	-	L	SHM	
Pug-nosed pipefish	*Pugnaso curtirostris*	-	-	L	SHM	
Robust pipehorse	*Solegnathus robustus*	-	-	L	SHM	
Spiny pipehorse,	*Solegnathus spinosissimus*	-	-	L	SHM	

Common name	Species name	EPBC Act status			Likely presence	BIA
		Listed Threatened	Listed Migratory	Listed marine		
Spotted pipefish	*Stigmatopora argus*	-	-	L	SHM	
Black pipefish	*Stigmatopora nigra*	-	-	L	SHM	
Ring-backed pipefish	*Stipecampus cristatus*	-	-	L	SHM	
Double-end pipehorse	*Syngnathoides biaculeatus*	-	-	L	SHM	
Hairy pipefish	*Urocampus carinirostris*	-	-	L	SHM	
Mother-of-pearl pipefish	*Vanacampus margaritifer*	-	-	L	SHM	
Port Phillip pipefish	*Vanacampus phillipi*	-	-	L	SHM	
Australian long-snout pipefish	*Vanacampus poecilolaemus*	-	-	L	SHM	
Verco's pipefish	*Vanacampus vercoi*	-	-	L	SHM	

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

Likely Presence
SHM: Species or species habitat may occur within area.
SHL: Species or species habitat likely to occur within area.
SHK: Species or species habitat known to occur within area.
BK: Breeding known to occur within area.

White shark

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

Observations of adult sharks are more frequent around fur-seal and sea lion colonies, including Wilsons Promontory and the Skerries. Juveniles are known to congregate in certain key areas including the Ninety Mile

Beach area (including Corner Inlet and Lakes Entrance) in eastern Victoria and the Portland area of western Victoria).

The distribution BIA for the white shark intersects the EMBAs and operational area (Figure 5-25). The known distribution is on the coastal shelf/upper slope waters out to 1000 m and the broader area where they are likely to occur extends from Barrow Island in WA to Yeppoon in NSW. They are more likely to be found between the 60–120 m depth contours than in the deeper waters. There is a known nursery area at Corner Inlet, and they are known to forage in waters off pinniped colonies throughout the SEMR. It is likely that white sharks are present in the operational area and EMBAs.

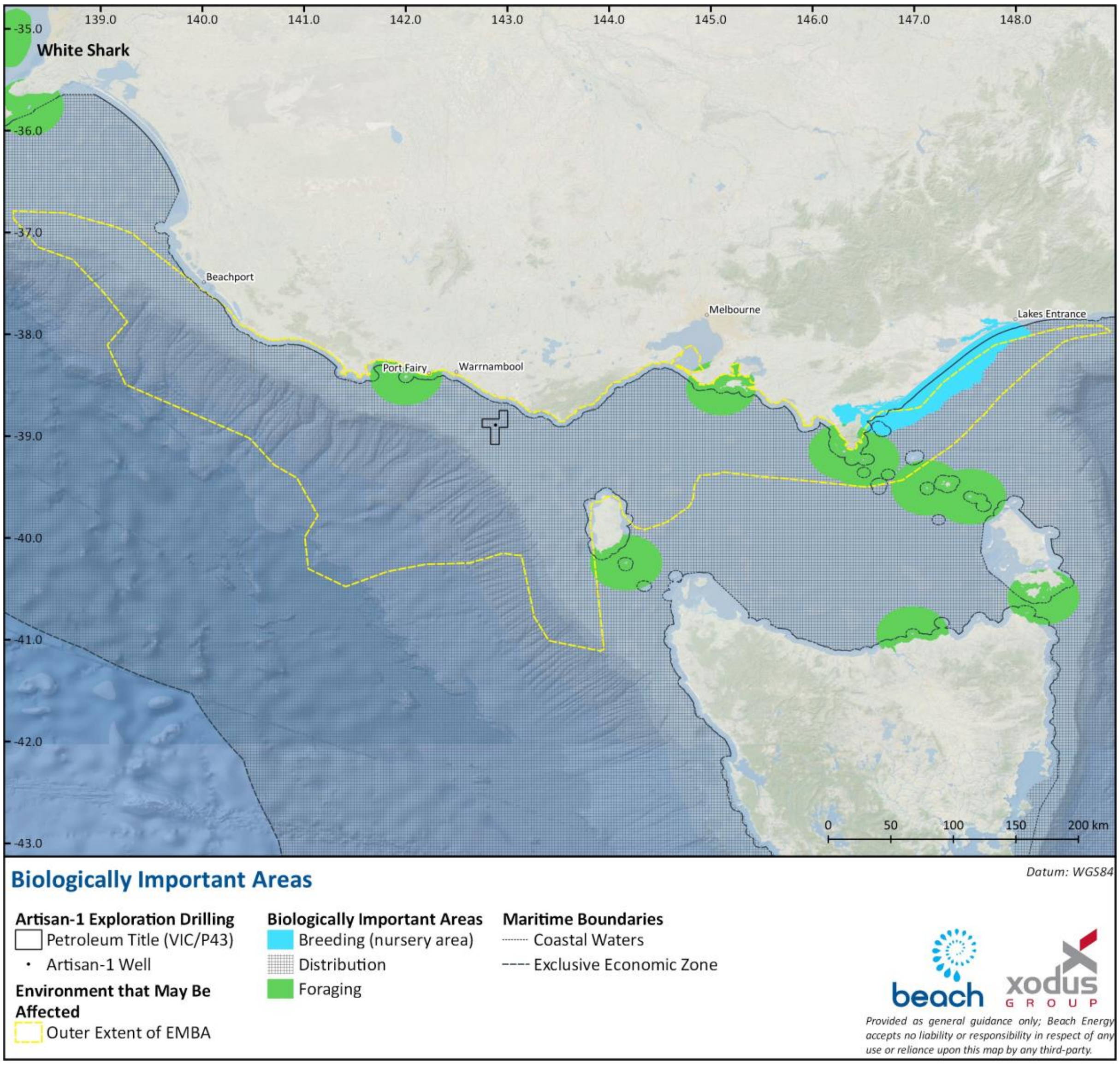


Figure 5-25: BIAs for the white shark

Shortfin mako shark

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

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

Porbeagle shark

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

Australian grayling

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

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

Whale shark

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

Syngnathids

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

Of the 26 species of syngnathids identified in the EPBC PMST Report, only one (*Hippocampus abdominalis*, big-belly seahorse) has a documented species profile and threats profile, indicating how little published information exists in general regarding syngnathids. The PMST Report species profile and threats profiles indicate that the syngnathid species listed in the EMBA are widely distributed throughout southern, south-eastern and south-western Australian waters. Therefore, it is unlikely that these species will be present in the operational area and EMBAs where water depths are greater than 50 m.

5.7.7.4 Birds

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

Bird species listed in the PMST reports, as possibly or known to occur in the operational area, light, waste water and spill EMBAs (this includes species or species habitat), are shown in Table 5-13. Those bird species listed in the noise EMBA PMST reports have not been included as underwater noise emissions are not identified as a potential impact to birds.

Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the operational area or light, waste water and spill EMBAs are discussed in more detail.

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

* species BIA identified see Section 5.7.7.2 and Table 5-11 for information as to which EMBAs overlap identified BIAs.

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Albatrosses									
Antipodean albatross*	*Diomedea antipodensis*	V	M	L	FL	✓	✓	✓	✓
Black-browed albatross*	*Thalassarche melanophris*	V	M	L	FL	✓	✓	✓	✓
Buller's albatross*	*Thalassarche bulleri*	V	M	L	FL	✓	✓	✓	✓
Campbell albatross*	*Thalassarche impavida*	V	M	L	FL	✓	✓	✓	✓
Chatham albatross	*Thalassarche eremita*	E	M	L	FL	✓			
Gibson's albatross	*Diomedea antipodensis gibsoni*	V	-	L	FL	✓			
Grey-headed albatross	*Thalassarche chrysostoma*	E	M	L	SHM	✓	✓	✓	✓
Indian yellow-nosed albatross*	*Thalassarche carteri*	V	M	L	FL	✓			
Northern buller's albatross	*Thalassarche bulleri platei*	V	-	-	FL	✓	✓	✓	✓
Northern royal albatross	*Diomedea sanfordi*	E	M	L	FL	✓	✓	✓	✓
Pacific albatross	*Thalassarche sp. nov.*	V		L	FL	✓	✓	✓	✓
Salvin's albatross	*Thalassarche salvini*	V	M	L	FL	✓	✓	✓	✓

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Shy albatross*	*Thalassarche cauta cauta*	V	M	L	FL	✓	✓	✓	✓
Sooty albatross	*Phoebetris fusca*	V	M	L	SHL	✓	✓	✓	✓
Southern royal albatross	*Diomedea epomophora*	V	M	L	FL	✓	✓	✓	✓
Tasmanian shy albatross	*Thalassarche cauta*	V	M	L	FL	✓			
Wandering albatross*	*Diomedea exulans*	V	M	L	FL	✓	✓	✓	✓
White-capped albatross	*Thalassarche cauti steadi* *Thalassarche steadi*	V	M	L	FL	✓	✓	✓	✓
Shearwaters									
Flesh-footed shearwater	*Ardenna carneipes*	-	M	L	SHK	✓	✓	✓	✓
Short-tailed shearwater*	*Ardenna tenuirostris*	-	M	L	BK	✓			
Sooty shearwater	*Ardenna grisea*	-	M		SHM		✓	✓	✓
Wedge-tailed shearwater*	*Ardenna pacifica*		M	L	BK	✓			
Petrels									
Blue petrel	*Halobaena caerulea*	V	-	L	SHM	✓	✓	✓	✓
Common diving petrel*	*Pelecanoides urinatrix*			L	BK	✓			

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Gould's petrel	*Pterodroma leucoptera*	E	-	-	SHM	✓	✓	✓	✓
Northern giant-petrel	*Macronectes halli*	V	M	L	SHM	✓	✓	✓	✓
Soft-plumaged petrel	*Pterodroma mollis*	V	-	L	FL	✓	✓	✓	✓
Southern giant-petrel	*Macronectes giganteus*	E	M	L	SHL	✓	✓	✓	✓
White-bellied storm-petrel	*Fregetta grallaria grallaria*	V	-	-	SHL	✓			
White-faced storm-petrel*	*Pelagodroma marina*	-	-	L	BK	✓			
Other									
Australasian bittern	*Botaurus poiciloptilus*	E	-	-	SHK	✓			
Australian fairy tern	*Sternula nereis*	V	-	-	BK	✓	✓	✓	✓
Australasian gannet*	*Morus serrator*	-	-	L	BK	✓			
Australian painted-snipe	*Rostratula australis*	E	-	-	SHL	✓			
Bar-tailed godwit	*Limosa lapponica bauera*	V	W	L	SHK	✓			
Black currawong	*Strepera fuliginosa colei*	V	-	-	BL	✓			

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Black-eared cuckoo	*Chrysococcyx osculans*	-	-	L	SHK	✓			
Black-faced cormorant*	*Phalacrocorax fuscescens*	-	-	L	BK	✓			
Black-faced monarch	*Monarcha melanopsis*	-	T	L	SHK	✓			
Black-tailed godwit	*Limosa limosa*	-	W	L	RK	✓			
Broad-billed sandpiper	*Limicola falcinellus*	-	W	L	RK	✓			
Cape gannet	*Morus capensis*	-	-	L	BK	✓			
Caspian tern	*Hydroprogne caspia*	-	M	L	BK	✓			
Caspian tern	*Sterna caspia*	-	-	L	BK	✓			
Cattle egret	*Ardea ibis*	-	-	L	SHM	✓			
Common noddy	*Anous stolidus*	-	M	L	SHL	✓			
Common greenshank	*Tringa nebularia*	-	W	L	SHK	✓			
Common sandpiper	*Actitius hypoleucos*	-	W	L	SHK	✓	✓	✓	✓
Crested tern	*Thalasseus bergii*	-	W	L	BK	✓			
Curlew sandpiper	*Calidris ferruginea*	CE	W	L	SHK	✓	✓	✓	✓
Double-banded plover	*Charadrius bicinctus*	-	W	L	RK	✓			

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Eastern curlew	*Numenius madagacariensis*	CE	W	L	SHK	✓	✓	✓	✓
Fairy prion	*Pachyptila turtur*			L	SHM	✓	✓	✓	✓
Fairy prion (southern)	*Pachyptila turtur subantarctica*	V		L	SHM	✓	✓	✓	✓
Fork-tailed swift	*Apus pacificus*	-	M	L	SHL	✓	✓		
Great egret	*Ardea alba*	-	-	L	BK	✓			
Great knot	*Calidris tenuirostris*	CE	W	L	RK	✓			
Greater sand plover	*Charadrius leschenaultia*	V	W	L	RK	✓			
Great skua	*Catharacta skua*	-	-	L	SHM	✓	✓	✓	✓
Green rosella	*Platycercus caledonicus brownie*	V	-	-	SHL	✓			
Grey plover	*Pluvialis squatarola*	-	W	L	RK	✓			
Grey-tailed tattler	*Tringa brevipes*	-	W	-	RK	✓			
Hooded plover	*Thinornis rubricollis rubricollis*	V	-	L	SHK	✓	✓		
Kelp gull	*Larus dominicanus*	-	-	L	BK	✓			
King Island brown thornbill	*Acanthiza pusilla archibaldi*	E	-	-	SHL	✓			
King Island scrubtit	*Acanthornis magna greeniana*	CE	-	-	SHK	✓			
Latham's snipe	*Gallinago hardwickii*	-	W	L	RK	✓			

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Lesser sand plover	*Charadrius mongolus*	E	W	L	RK	✓			
Little curlew	*Numenius minutus*	-	W	L	RL	✓			
Little penguin*	*Eudyptula minor*	-	-	L	BK	✓			
Little tern	*Sternula albifrons*	-	M	L	BK	✓			
Magpie Goose	*Anseranas semipalmata*	-	-	L	SHM	✓			
Marsh sandpiper	*Tringa stagnatilis*	-	W	L	RK	✓			
Northern siberian bar-tailed godwit	*Limosa lapponica menzbieri*	CE	-	-	SHM	✓			
Pacific gull	*Larus pacificus*	-	-	L	BK	✓			
Orange-bellied parrot	*Neophema chrysogaster*	CE	-	L	MK	✓	✓		
Osprey	*Pandion haliaetus*	-	W	L	SHK	✓	✓	✓	
Pacific golden plover	*Pluvialis fulva*	-	W	L	RK	✓			
Painted honeyeater	*Grantiella picta*	V	-	-	SHL	✓			
Painted snipe	*Rostratula benghalensis (sensu lato)*	E	-	L	SHL	✓			
Pectoral sandpiper	*Calidris melanotos*	-	W	L	SHK	✓	✓	✓	✓

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Pied stilt	*Himantopus himantopus*	-	-	L	RK	✓			
Pin-tailed snipe	*Gallinago stenura*	-	W	L	RL	✓			
Plains-wanderer	*Pedionomus torquatus*	CE	-	-	SHL	✓			
Rainbow bee-eater	*Merops ornatus*	-	-	L	SHM	✓			
Red-capped plover	*Charadrius ruficapillus*	-	-	L	RK	✓			
Red-necked avocet	*Recurvirostra novaehollandiae*	-	-	L	RK	✓			
Red-necked phalarope	*Phalaropus lobatus*	-	W	L	RK	✓			
Regent honeyeater	*Anthochaera Phrygia*	CE	-	-	FL	✓			
Red knot	*Calidris canutus*	E	W	L	SHK	✓	✓	✓	✓
Red-necked stint	*Calidris ruficollis*	-	W	L	RK	✓			
Ruddy turnstone	*Arenaria interpres*	-	W	L	RK	✓			
Ruff (Reeve)	*Philomachus pugnax*	-	M	L	SHL	✓			
Rufous fantail	*Rhipidura rufifrons*	-	T	L	SHK	✓			
Sanderling	*Calidris alba*	-	W	L	RK	✓			
Satin flycatcher	*Myiagra cyanoleuca*	-	T	L	BK	✓			
Sharp-tailed sandpiper	*Calidris acuminata*	-	W	L	RK	✓	✓	✓	✓

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					
Silver gull	*Larus novaehollandiae*	-	-	L	BK	✓			
Sooty tern	*Sterna fuscata*	-	-	L	BK	✓			
Swift parrot	*Lathamus discolour*	CE	-	-	SHK	✓			
Swinhoe's snipe	*Gallinago megala*	-	W	L	RL	✓			
Tasmanian azure kingfisher	*Ceyx azureus diemenensis*	E	-	-	SHM	✓			
Tasmanian wedge-tailed eagle	*Aquila audax fleayi*	E	-	-	SHL	✓			
Terek sandpiper	*Xenus cinereus*	-	W	L	RK	✓			
Wandering tattler	*Tringa incana*	-	W	-	RK	✓			
Whimbrel	*Numenius phaeopus*	-	W	L	RK	✓			
White-bellied sea-eagle	*Haliaeetus leucogaster*	-	-	L	BK	✓			
White-throated needletail	*Hirundapus caudacutus*	-	T	L	SHK	✓			
Wood sandpiper	*Tringa glareola*	-	W	L	RK	✓			
Yellow wagtail	*Motacilla flava*	-	T	L	SHM	✓			

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light EMBA (20 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed Threatened	Listed Migratory	Listed marine					

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

Listed Migratory
- M: Migratory

Listed Marine
- L: Listed

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

Albatross and petrels

Albatrosses and giant-petrels are among the most dispersive and oceanic of all birds, spending more than 95% of their time foraging at sea in search of prey and usually only returning to land (remote islands) to breed. The National Recovery Plan for threatened albatross and giant petrels (DSEWPaC, 2011a). Only seven species of albatross and the southern and northern giant petrel are known to breed within Australia, which are protected under The National Recovery Plan for threatened albatross and giant petrels (DSEWPaC, 2011a). Breeding within Australian territory occurs on the isolated islands of Antarctica (Giganteus Island, Hawker Island and Frazier islands) and the Southern Ocean (Heard Island, McDonald Island, Macquarie Island, Bishop and Clerk Islands), as well as islands off the south coast of Tasmania and Albatross Island off the north-west coast of Tasmania in Bass Strait (DSEWPaC, 2011b). There are no islands with colonies of threatened marine seabirds within the EMBAs. Albatross Island, supporting a breeding population of approximately 5,000 shy albatross (*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, Indian yellow-nosed albatross, shy albatross and wandering albatross, have BIAs for foraging that overlap the operational area and the EMBAs (Figure 5-26, Figure 5-27 and Figure 5-28). These BIAs cover either most or all the SEMR (Commonwealth of Australia, 2015). Therefore, it is likely that these will be present and forage in the operational area and EMBAs.

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

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

The white-bellied storm petrel breed on small offshore islets and rocks in Lord Howe Island and has been recorded over near-shore waters off Tasmania (Baker et al. 2002). The great-winged petrel breeds in the Southern Hemisphere between 30° and 50° south, outside of the breeding season they are widely dispersed (Birdlife International, 2019)

Terns and shearwaters

The flesh-footed shearwater is a trans-equatorial migrant widely distributed across the south-western Pacific during breeding season (early September to early May) and is a common visitor to the waters of the continental shelf/slope and occasionally inshore waters. The species breeds in burrows on sloping ground in coastal forest, scrubland, shrubland or grassland. Thirty-nine of the 41 islands on which the species breeds lie off the coast of southern Western Australia, with the remaining two islands being Smith Island (SA) and Lord Howe Island. The flesh-footed shearwater feeds on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), other soft-bodied invertebrates (such as Velella) and offal. The species forages almost entirely at sea and very rarely on land. It obtains most of its food by surface plunging or pursuit plunging. It also regularly forages by settling on the surface of the ocean and snatching prey from the surface ('surface seizing'), momentarily submerging onto prey beneath the surface ('surface diving') or diving and pursuing prey beneath the surface by swimming ('pursuit diving'). Birds have also been observed flying low over the ocean and pattering the water with their feet while picking food items from the surface (termed 'pattering') (DotEE, 2014). This species is likely to be an uncommon visitor to the operational area and EMBAs.

The short-tailed shearwater has foraging and breeding BIAs within the spill EMBA (Figure 5-28) and the foraging BIA is within the light EMBA (Figure 7-13). The short-tailed shearwater is migratory, and breeding is restricted to southern Australia being most abundant in Victoria and Tasmania (Skira et al., 1996). Huge numbers arrive along the south and south-east coast of Australia from wintering grounds in the North Pacific and are observed in large numbers foraging the surrounding coastal and offshore waters (Marchant & Higgins, 1990). Short-tailed shearwaters have been identified as a conservation value in the temperate east and south-west marine areas.

The wedge-tailed shearwater has a foraging and breeding BIA within the operational area and EMBAs (Figure 5-28 and Figure 7-13). A review of the DAWE Species Profile and Threats Database (SPRAT), Atlas of Living Australia and South-east Marine Region Profile did not provide any information on the Victorian Muttonbird Island wedge-tailed shearwater colony. The DAWE SPRAT profile does not show any locations for the wedge-tailed shearwater in Victoria and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of Wedge-tail shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border.

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

The sooty tern has a much larger foraging range, encompassing open shelf waters, shelf edge and deep water (DSEWPaC, 2012b). Main breeding colonies occur off Australia’s west and east coast. Like the crested tern where distribution is widespread in Australia, but breeding occurs off islands in large colonies off Queensland and New South Wales (Higgins & Davis, 1996). Foraging diet consists of pelagic fish, cephalopods, crustaceans and insects.

Osprey and white bellied sea eagle

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

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

Orange-bellied parrot

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

Little penguin

The little penguin is the smallest species of penguin in the world and are permanent residents on a number of inshore and offshore islands. The Australian population is large but not thought to exceed one million birds (DoE, 2015a). Bass Strait has the largest proportion (approximately 60%) of the known breeding colonies in Australia; however, breeding populations are also found on the New South Wales coast. Individuals exhibit strong site fidelity, returning to the same breeding colony each year to breed in the winter and spring months (Gillanders *et al.*, 2013). The diet of a Little Penguin includes small school fish, squid and krill. Prey is typically caught with rapid jabs of the beak and swallowed whole. A BIA for breeding and foraging, has been identified for breeding and foraging of the Little Penguin within the EMBA (Figure 5-27). Their main breeding site within the spill EMBA is in Western Port Bay. Little penguins are also an important component of the Australian and New Zealand fur-seals' diet (Parliament of South Australia, 2011).

Australasian gannet

The Australasian gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers. Breeding is highly seasonal (October–May), nesting on the ground in small but dense colonies (DoE, 2015a). Important breeding locations for the Australasian gannet within the Environment Sectors include Pedra Branca, Eddystone Rocks, Sidmouth Rocks, and Black Pyramid (Tasmania) and Lawrence Rocks (Victoria). A BIA, for foraging, has been established in the spill EMBA with substantial foraging sites within port Philip Bay and Port Fairy (Figure 5-26).

Other shorebirds

A number of species listed in Table 5-13 use coastal shoreline habitats such as Australian fairy tern, fairy prion, red knot, pectoral sandpiper, fork-tailed swift, sharp-tailed sandpiper, curlew sandpiper, eastern curlew, little curlew, yellow wagtail, Australasian bittern and species of plover. These species are commonly found on coastal shores including beaches and rocky shores and either feed at low tide on worms, crustaceans and molluscs or fish species or feed on aquatic biota (Parks Victoria, 2016). This species is unlikely to be present in the EMBAs due to the distance offshore.

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

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

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

Other waders including common noddy, ruddy turnstone, sanderling, red-necked stint, whimbrel, common greenshank, pied stilt, white-throated needletail, red-necked phalarope, ruff, red-necked avocet, rufous fantail and black-faced cormorant are common along Australia's coastline. The black-faced cormorant has a breeding and foraging BIA off King Island within the spill EMBA. Many of these waders are migratory travelling from the Northern Hemisphere in non-breeding months. Most inhabit intertidal mudflats, rocky islets, sand beaches, mangroves, rocky coastline and coral reefs. Roosting occurs in similar habitats and species are found feeding on fish, crustaceans, aquatic insects, as well as plants and seeds (Higgins & Davies, 1996). These species are unlikely to be present in the operational area, light and waste water EMBAs due to the distance offshore. The plains wanderer is a unique bird that lives predominantly in grasslands in Victoria, South Australia, New South Wales and Queensland. The swift parrot is a small parrot breeding in colonies in Tasmania. The entire population migrates to the mainland during winter. The great knot is critically endangered migratory arriving in large numbers in Australia occurring in sheltered coastal habitats with large intertidal mudflats. Typically, they roost in large open areas at the water's edge to in shallow water close to foraging grounds (Higgins & Davies 1996). These species are critically endangered and may occur within the spill EMBA.

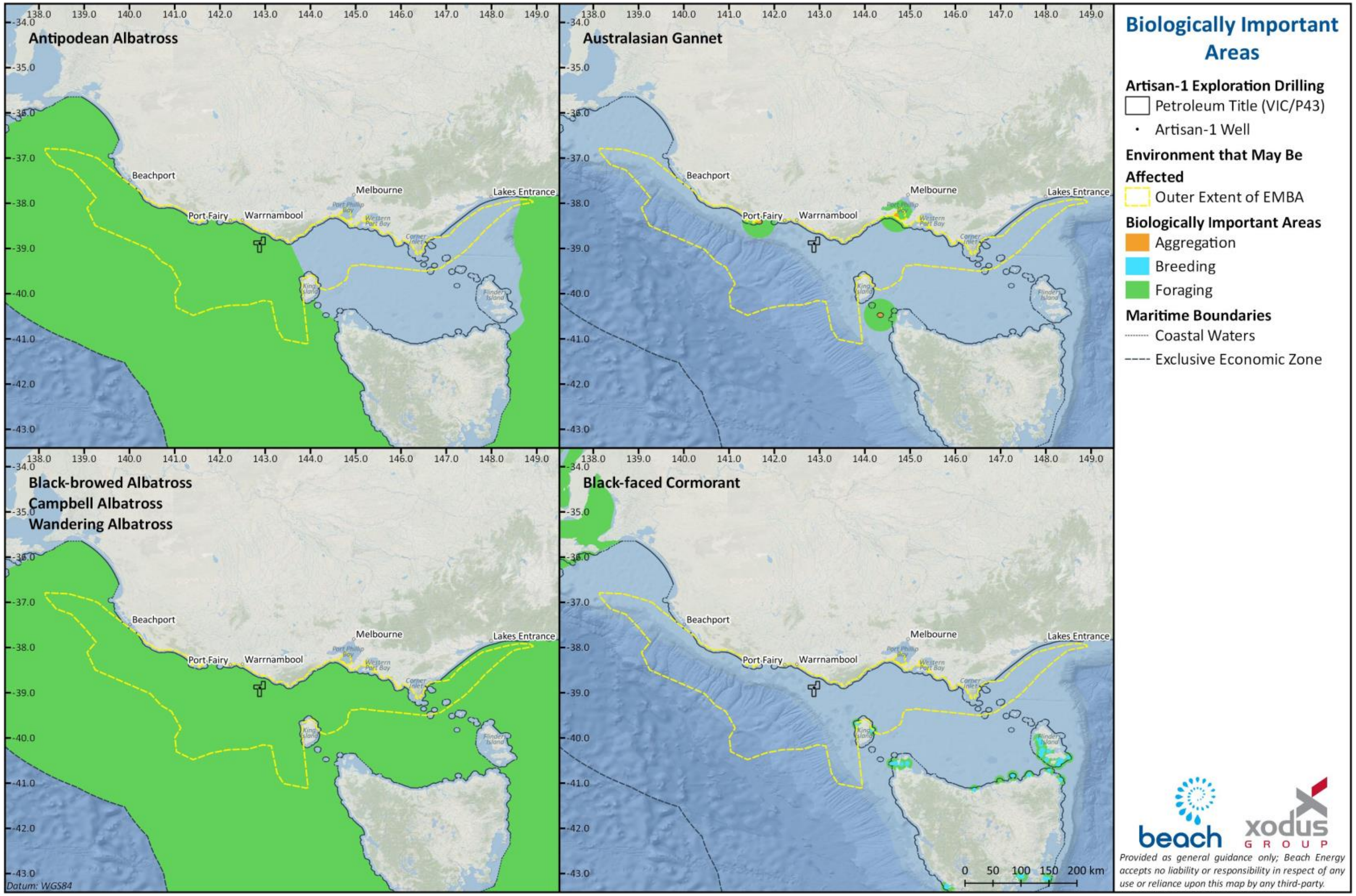


Figure 5-26: BIAs for Antipodean albatross, Australasian gannet, black-browed albatross, Campbell albatross, wandering albatross and black-faced cormorant within the spill EMBA

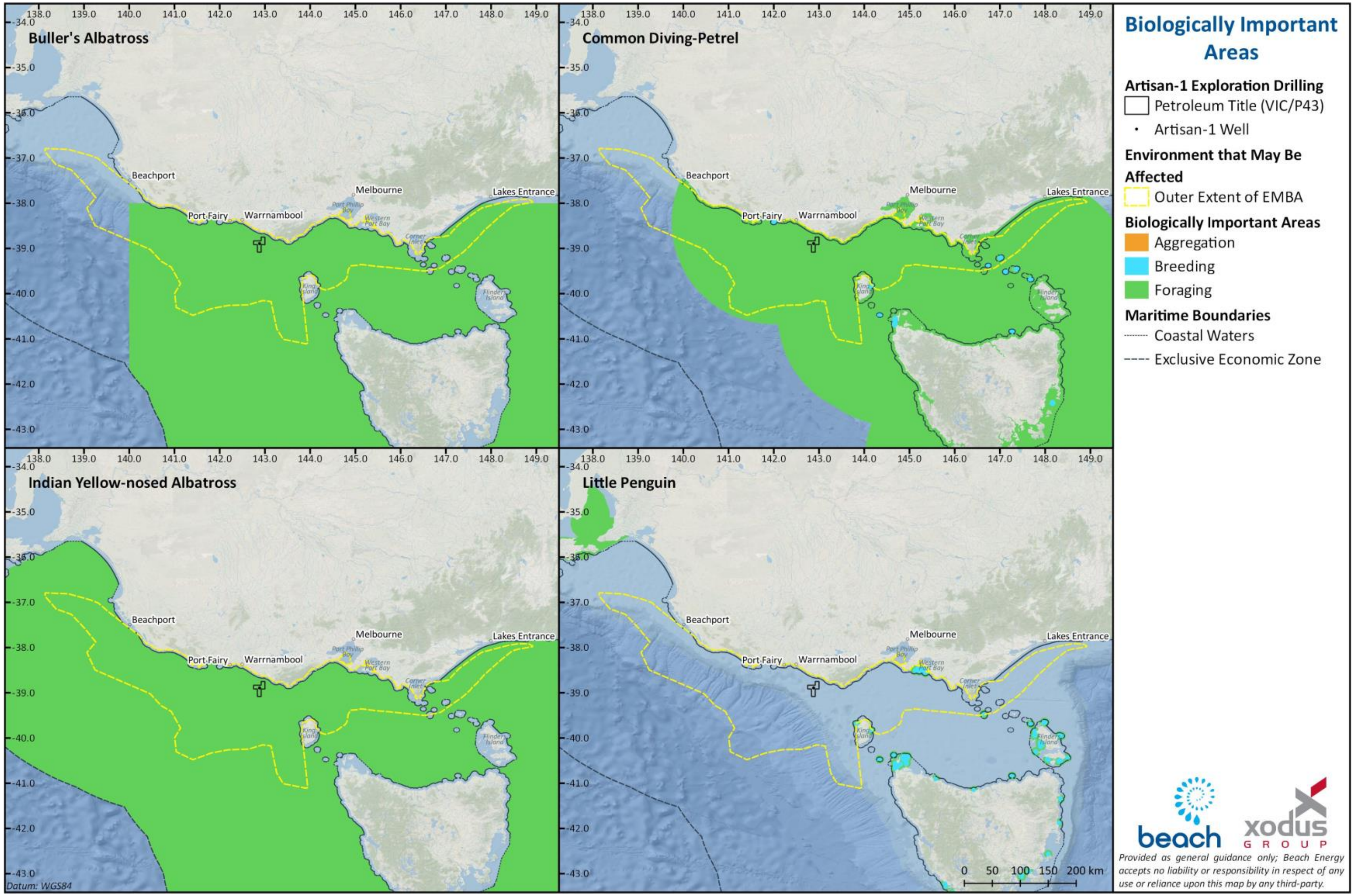


Figure 5-27: BIAs for the Buller's albatross, common diving-petrel, Indian yellow-nosed albatross and little penguin within the spill EMBA

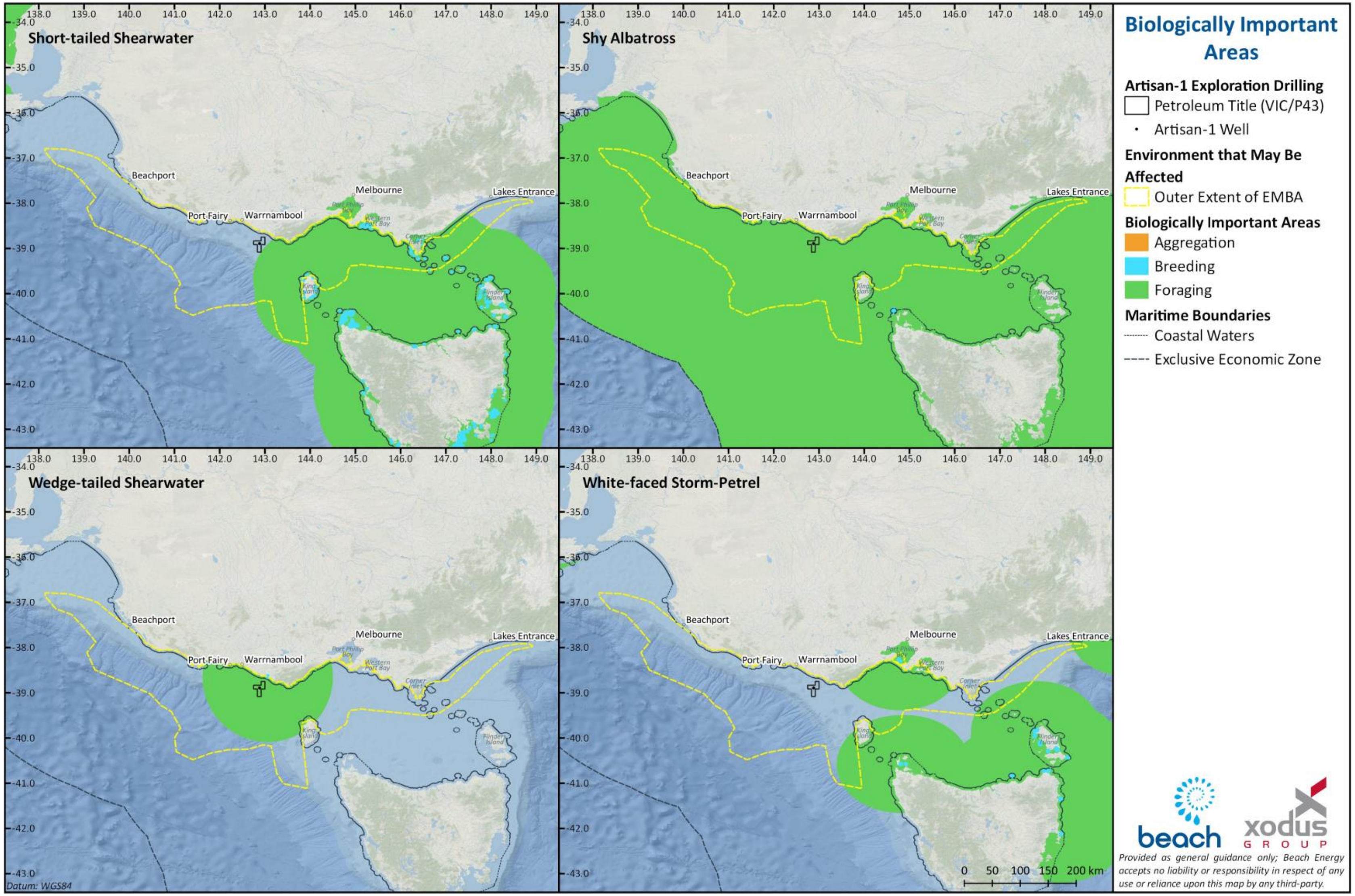


Figure 5-28: BIAs for short-tailed shearwater, shy albatross, wedge-tailed shearwater and white-faced storm petrel within the spill EMBA

5.7.7.5 Marine reptiles

The PMST reports for the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs identified three marine turtle species likely to occur within the EMBAs (Appendix A.1 to A.5). All three species of marine turtles are protected by the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). The spill EMBA PMST report identifies that feeding is known to occur in the spill EMBA for all species. Feeding was not identified in the light and noise behaviour, noise 24 hr and waste water EMBAs PMST Reports. There are no identified BIAs for these reptiles in the operational area and EMBAs.

Table 5-14: Listed turtle species identified in the PMST

Common name	Species name	EPBC Act status			Likely presence
		Listed threatened	Listed migratory	Listed marine	
Loggerhead turtle	*Caretta caretta*	E	M	L	FK
Green turtle	*Chelonia mydas*	V	M	L	FK
Leatherback turtle	*Dermochelys coriacea*	E	M	L	FK
Listed Threatened E: Endangered V: Vulnerable Listed Migratory M: Migratory Listed Marine L: Listed		Likely Presence FK: Foraging, feeding or related behaviour likely to occur within area			

Loggerhead turtle

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

The main Australian breeding areas for loggerhead turtles are generally confined to southern Queensland and Western Australia (Cogger et al., 1993). Loggerhead turtles will migrate over distances in excess of 1,000 km but show a strong fidelity to their feeding and breeding areas (Limpus, 2008). Loggerhead turtles forage in all coastal states and the Northern Territory, but are uncommon in South Australia, Victoria and Tasmania (Commonwealth of Australia, 2017b). Due to waters depths it is unlikely loggerhead turtles would be present in the operational area and EMBAs.

Green turtle

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

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

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

5.7.7.6 Cetaceans

The PMST reports identified several cetaceans that potentially occur in the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs (Appendix A). Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the operational area and EMBAs are discussed in more detail in the sections below.

Gill et al., (2015) summarised cetacean sightings from 123 systematic aerial surveys undertaken over western Bass Strait and the eastern Great Australian Bight between 2002 and 2013. This paper does not include sighting data for blue whales, which has previously been reported in Gill et al., (2011) (Figure 5-31 and Figure 5-32).

These surveys recorded 133 sightings of 15 identified cetacean species consisting of seven mysticete (baleen) whale species, eight odontocete (toothed) species and 384 sightings of dolphins (Table 5-16 and Table 5-17). Survey effort was biased toward coverage of upwelling seasons, corresponding with pygmy blue whales’ seasonal occurrence (November to April; 103 of 123 surveys), and relatively little survey effort occurred during 2008–2011. Cetacean species sighted within the region are described in the following sections.

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

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

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.

Origin Energy conducted a survey for cetaceans focused on Origin operations and permit in the Otway basin from June 2012 through to March of 2013. Table 5-18 lists the species present in the area Origin surveyed.

Table 5-15: Listed cetacean species identified in the PMST reports

* species BIA identified see Section 5.7.7.2 and Table 5-11 for information as to which EMBAs overlap identified BIAs.

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light and Noise Behaviour EMBA (20km)	Noise 24 hr EMBA (3 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed threatened	Listed migratory	Listed marine						
Whales										
Arnoux's beaked whale	*Berardius arnuxii*	-	-	L	SHM	✓				
Andrew's beaked whale	*Mesoplodon bowdoini*	-	-	L	SHM	✓				
Antarctic minke whale	*Balaenoptera bonaerensis*	-	M	L	SHL	✓				
Blainville's beaked whale	*Mesoplodon desirostris*	-	-	L	SHM	✓				
Blue whale*	*Balaenoptera musculus*	E	M	L	FK	✓	✓	✓	✓	✓
Bryde's whale	*Balaenoptera edeni*	-	M	L	SHM	✓				
Curvier's beaked whale	*Ziphius cavirostris*	-	-	L	SHM	✓				
Dwarf sperm whale	*Kogia simus*	-	-	L	SHM	✓				
False killer whale	*Pseudorca crassidens*	-	-	L	SHL	✓	✓	✓	✓	✓
Fin whale	*Balaenoptera physalus*	V	M	L	FK	✓	✓	✓	✓	✓

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light and Noise Behaviour EMBA (20km)	Noise 24 hr EMBA (3 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed threatened	Listed migratory	Listed marine						
Gray's beaked whale	*Mesoplodon grayi*	-	-	L	SHM	✓				
Hector's beaked whale	*Mesoplodon hectori*	-	-	L	SHM	✓				
Humpback whale	*Megaptera novaeangliae*	V	M	L	SHK	✓	✓	✓	✓	✓
Killer whale, orca	*Orcinus orca*	-	M	L	SHL	✓	✓	✓	✓	✓
Long-finned pilot whale	*Globicephala melas*	-	-	L	SHM	✓				
Minke whale	*Balaenoptera acutorostrata*	-	-	L	SHM	✓	✓	✓	✓	✓
Pygmy right whale	*Caperea marginata*	-	M	L	FL	✓	✓	✓	✓	✓
Pygmy sperm whale	*Kogia breviceps*	-	-	L	SHM	✓				
Shepherd's beaked whale	*Tasmacetus shepherdi*	-	-	L	SHM	✓				
Sei whale	*Balaenoptera borealis*	V	M	L	FK	✓	✓	✓	✓	✓
Short-finned pilot whale	*Globicephala macrorhynchus*	-	-	L	SHM	✓				
Southern bottlenose whale	*Hyperoodon planifrons*	-	-	L	SHM	✓				

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light and Noise Behaviour EMBA (20km)	Noise 24 hr EMBA (3 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed threatened	Listed migratory	Listed marine						
Southern right whale*	Balaena glacialis australis	E	M	L	BK	✓	✓	✓	✓	✓
Sperm whale	*Physeter macrocephalus*	-	M	L	SHM	✓				
Strap-toothed beaked whale	*Mesoplodon layardii*	-	-	L	SHM	✓				
True's beaked whale	*Mesoplodon mirus*	-	-	L	SHM	✓				
Dolphins										
Bottlenose dolphin	*Tursiops truncates*	-	-	L	SHM	✓	✓	✓	✓	✓
Common dolphin	*Delphinus delphis*	-	-	L	SHM	✓	✓	✓	✓	✓
Dusky dolphin	*Lagenorhynchus obscures*	-	M	L	SHL	✓	✓	✓	✓	✓
Indian ocean bottlenose dolphin	*Tursiops aduncus*	-	-	L	SHL	✓	✓			
Risso's dolphin	*Grampus griseus*	-	-	L	SHM	✓	✓	✓	✓	✓
Southern right whale dolphin	*Lissodelphis peronii*	-	-	L	SHM	✓				

Common name	Species name	EPBC Act status			Likely presence	Spill EMBA	Light and Noise Behaviour EMBA (20km)	Noise 24 hr EMBA (3 km)	Waste water EMBA (2.5 km)	Operational area (2 km)
		Listed threatened	Listed migratory	Listed marine						

Listed Threatened

E: Endangered

V: Vulnerable

Listed Migratory

M: Migratory

Listed Marine

L: Listed

Table 5-16: Cetacean species recorded during aerial surveys 2002–2013 in southern Australia

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

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

Table 5-17: Temporal occurrence across months of cetaceans sighted during aerial surveys from November 2002 to March 2013 in southern Australia

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

*Species sighted 2 or fewer times.

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

Table 5-18: Observed cetaceans in the Otway Basin

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

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

Blue whale

The blue whale (*Balaenoptera musculus*) is listed as an endangered species under the Australian Government EPBC Act (1999) and the IUCN Red List. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the pygmy blue whale (*B. m. brevicauda*) and the Antarctic blue whale (*B. m. intermedia*). The pygmy blue whale has a foraging BIA within the EMBAs and operational area (Figure 5-33). Reference to blue whale unless otherwise specified is generally synonymous to both species. The blue whale has a recovery plan that identifies threats and establishes actions for assisting the recovery of blue whale populations using Australian waters (Commonwealth of Australia, 2015b).

Antarctic blue whale

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.

Antarctic blue whales are mainly sighted south of 60°S in Antarctic waters. Little is known about mating behaviour or breeding grounds. The Otway region is an important migratory and foraging area for blue whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov, 2012; McCauley et al., 2018; Gill et al., 2011).

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

Important foraging grounds for blue whales include the Great Australian Bight, South Australia and off Portland Victoria where blue whales visit between December and June to forage on the inshore shelf break. Sighting data indicates that blue whales are seasonally distributed. 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 5-30).

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 5-31). However, 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 (Figure 5-32). 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.

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.

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

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.

Pygmy blue whale

There is no current population estimate for the pygmy blue whale and abundance pre-exploitation is uncertain. The pygmy blue whale is primarily distributed north of 55°S. They are most abundant in the southern Indian Ocean on the Madagascar plateau, and off South Australia and Western Australia in the Southern and Indian Oceans, where they are distributed between Tasmania and Indonesia.

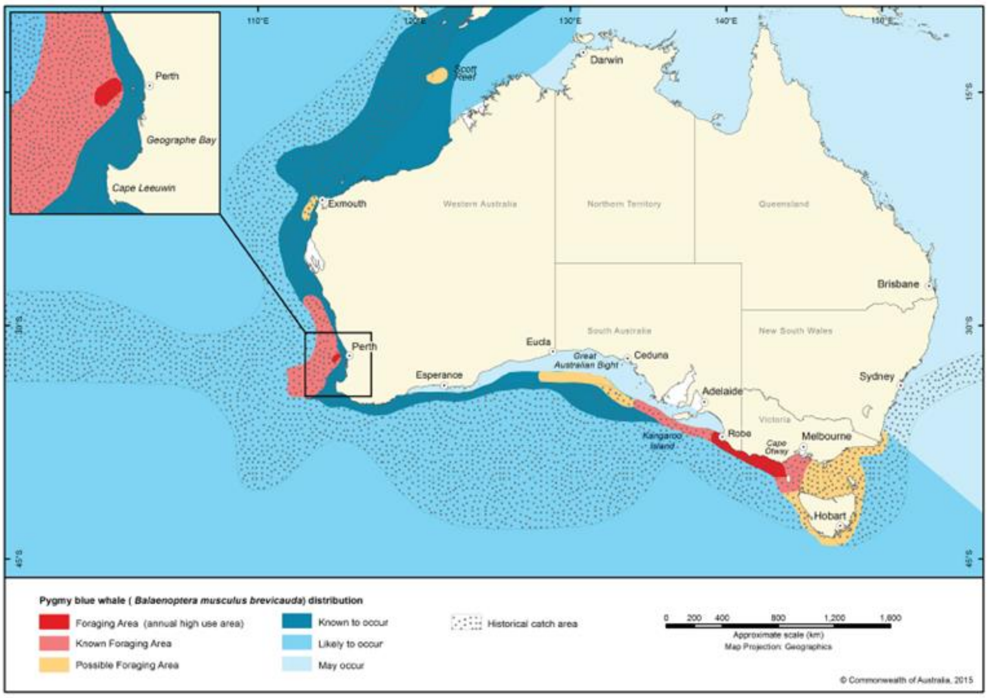
There are two known seasonal feeding aggregations areas in Australia, one adjacent to the Bonney coast off South Australia and Victoria (Figure 5-29), and the other off the Perth Canyon in Western Australia. The abundance of pygmy blue whales varies within and between seasons, but they typically forage in the Otway region between January and April. Foraging of pygmy blue whales is known to occur in Bass Strait and the west coast of Tasmania where they have been recorded diving at depth presumably feeding (Commonwealth of Australia. 2015). McCauley et al. (2018) suggests that acoustic detection of pygmy blue whales indicate they predominantly occur west of Bass Strait. 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.

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

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

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

BIAs for pygmy blue whales have been identified around Australia with the foraging BIA intersecting the operational area and EMBAs (Figure 5-33). Encounters with blue whales and drilling activities is possible during December to May. Surveys 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.



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

Figure 5-29: Pygmy blue whale foraging areas around Australia (Commonwealth of Australia, 2015b)

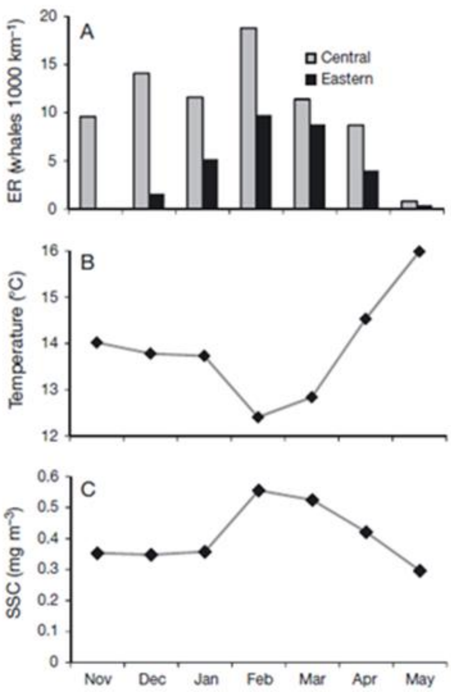


Figure 5-30: Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month (Gill et al., 2011)

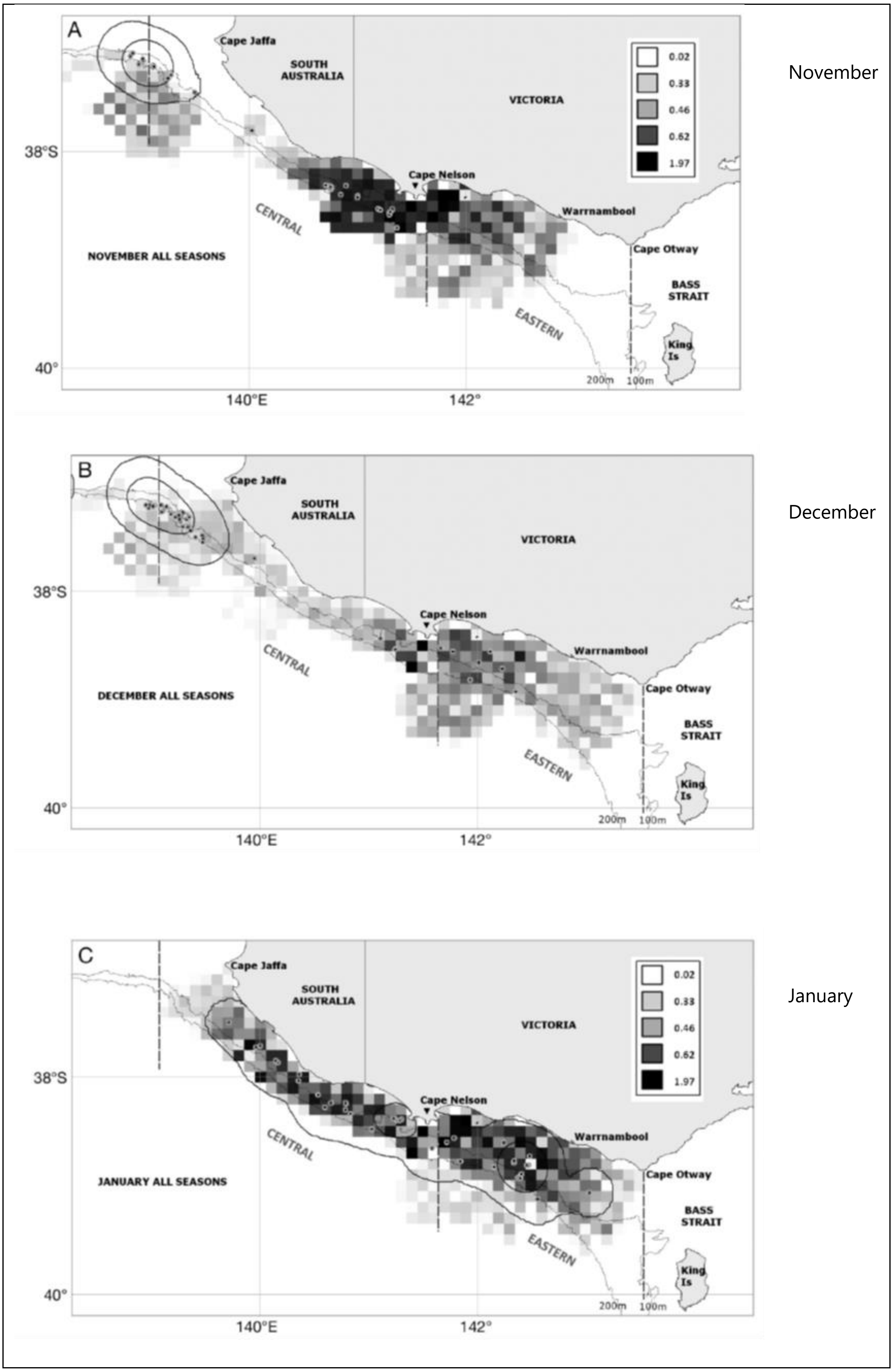


Figure 5-31: Blue whale sightings in the Otway Basin (Nov, Dec, Jan) (Gill et al., 2011)

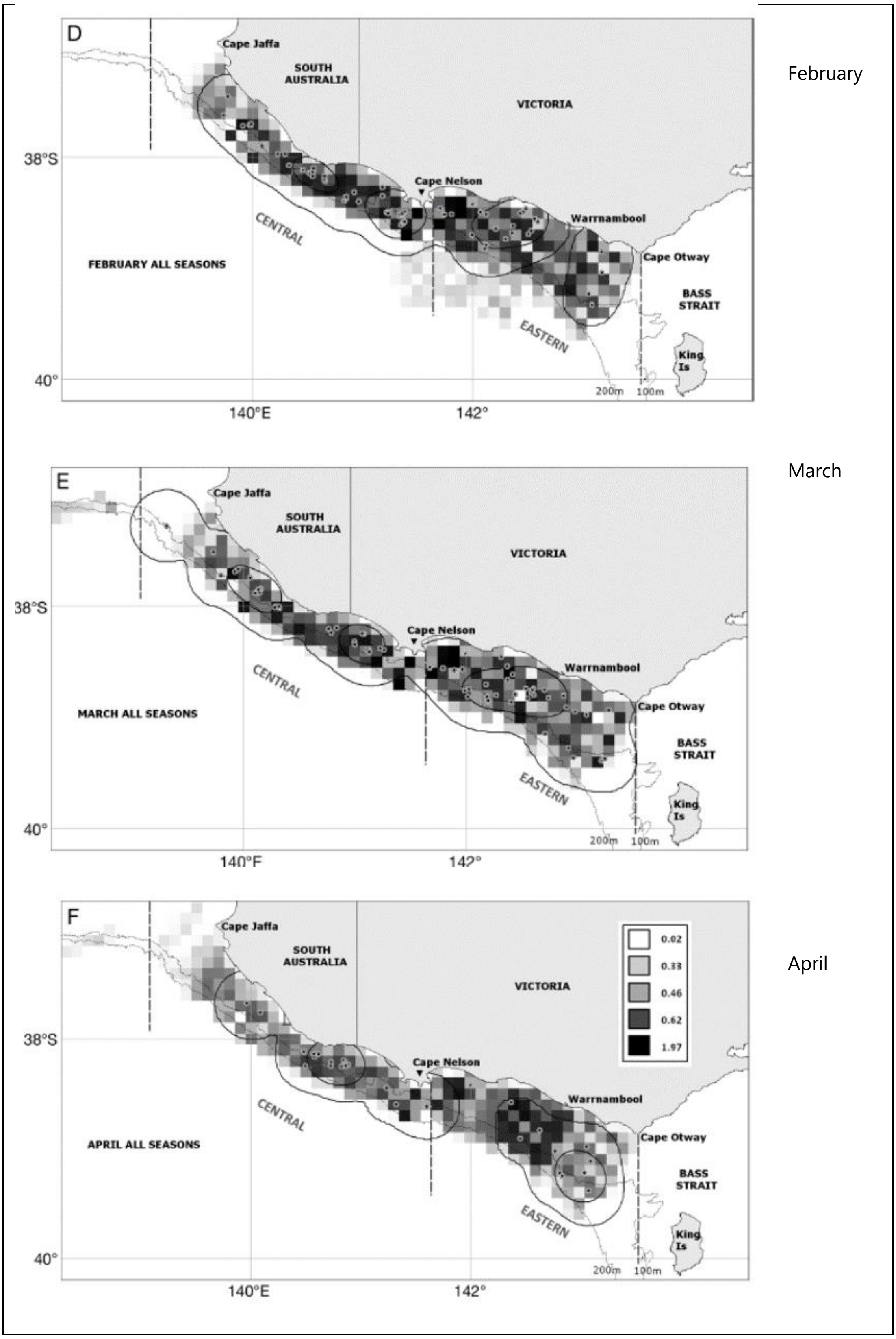


Figure 5-32: Blue whale sightings in the Otway Basin (Feb, Mar, Apr) (Gill et al., 2011)

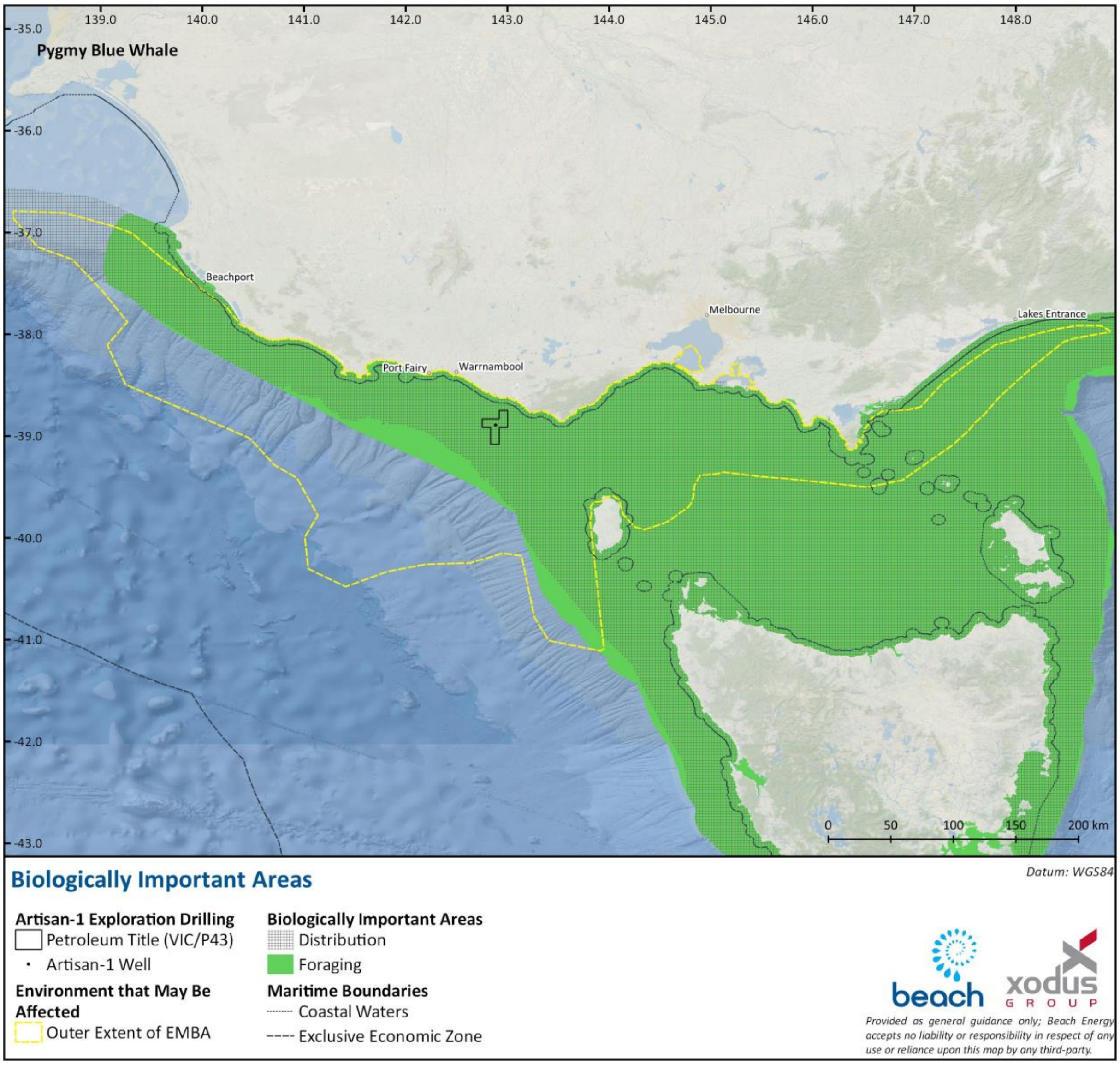


Figure 5-33: BIA for the pygmy blue whale within the spill EMBA.

Southern right whale

The spill EMBA overlaps the southern right whale (*Eubalaena australis*) aggregation, connecting habitat, migration and current core coastal range (Figure 5-34). The operational area, light and noise behaviour, noise 24 hr and waste water EMBAs overlaps the current core coastal range. The operational area is 32 km from the aggregation BIA, 25 km from the migration BIA and 115 km from the connecting habitat BIA (Figure 7-15).

The southern right whale is listed as endangered under the EPBC Act in Australia and as critically endangered on the Victorian Threatened Species Advisory List. Southern right whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al., 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because southern right whales have a slow rate of increase (7% per annum (p.a.)) compared to other marine mammals, their numbers remain low (IWC, 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia and New Zealand.

The Australian population of southern right whales is divided into two sub-populations due to genetic diversity (Carroll et al., 2011; Baker et al., 1999) and different rates of increase (DSEWPaC, 2012a). The western sub-population occurs predominantly between Cape Leeuwin, Western Australia (WA) and Ceduna, South Australia (SA) This sub-population comprises most of the Australian population and is estimated at 3,200 individuals increasing at an annual rate of approximately 6 % p.a. (Smith et al., 2019). The eastern sub-population can be found along the south-eastern coast, including the region from Tasmania to Sydney, with key aggregation areas in Portland and Warrnambool in Victoria. The eastern sub-population is estimated at less than 300 individuals and is showing no signs of increase (Bannister, 2017). A rate of around 7% p.a. is considered the maximum biological rate of increase for southern right whales (IWC, 2013). Connectivity between the two populations is unknown however, some limited movement between the two areas has been recorded (Burnell, 2001; Charlton, 2017; Pirzl et al., 2009).

Southern right whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al., 1996). They are distributed across thirteen primary aggregation areas along the southern coast of Australia (Figure 5-35: Aggregation areas for southern right whales (DSEWPaC, 2012) (DSEWPaC, 2012a). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (DSEWPaC, 2012a). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (DSEWPaC, 2012a).

The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by southern right whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA (DSEWPaC, 2012a). Southern right whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al., 2019). A number of additional areas for southern right whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (DSEWPaC, 2012a).

Coastal connecting habitat, which may also serve a migratory function or encompass locations that will emerge as calving habitat as recovery progresses (some locations within connecting habitat are occupied intermittently but do not yet meet criteria for aggregation areas) (DSEWPaC, 2012a). A portion of the King Island connecting habitat BIA is within the spill EMBA.

There is variation in annual abundance on the coast of Australia due to the 3-year calving cycles (Charlton 2017). Female and calf pairs generally stay within the calving ground for 2–3 months (Burnell, 2001). Peak periods for mating in Australian coastal waters are from mid-July through August (DSEWPaC, 2012a). Pregnant females generally arrive during late May/early June and calving/nursery grounds are generally occupied until October (occasionally as early as April and as late as December) (Charlton et al., 2019).

As a highly mobile migratory species, southern right whales travel thousands of kilometres between habitats used for essential life functions. Movements along the Australian coast are reasonably well understood, but little is known of migration travel, non-coastal movements and offshore habitat use. Exactly where southern right whales approach and leave the Australian coast from, and to, offshore areas remain unknown (DSEWPaC, 2012a). A defined near-shore coastal migration corridor is unlikely given the absence of any predictable directional movement of southern right whales such as that observed for humpback whales. A predominance of westward movements amongst long-range photo-identification re-sightings may indicate a seasonal westward movement in coastal habitat (Burnell, 2001). Direct approaches and departures to the coast have also been recorded through satellite telemetry studies (Mackay et al. 2015).

Aerial surveys of western Bass Strait and eastern Great Australian Bight undertaken by Gill et al., (2015) detected southern right whales between May and September. A survey in early November 2010 did not observe any whales in the Warrnambool area and it was assumed that cows and calves had already left the calving and aggregation areas (M. Watson, pers. comm., 2010). No southern right whales were encountered during Origin's Enterprise 3D seismic survey undertaken during November 2014 (RPS, 2014), or during spotter flights of the coastline undertaken prior to the survey in late October 2014. Aerial surveys between Ceduna, SA and Sydney NSW (and included Tasmania) were undertaken in August of 2013 and 2014 and recorded a total of 34 southern right whale individuals (17 breeding females) in 2013 and 39 (11 breeding females) in 2014, respectively (Watson et al., 2015).

The conservation management plan for the southern right whale (DSEWPaC, 2012a) reports that known and potential threats that may have individual or population level impacts to southern right whales include: entanglement in fishing gear, vessel disturbance, climate variability and change, noise interference, habitat modification and overharvesting of prey.

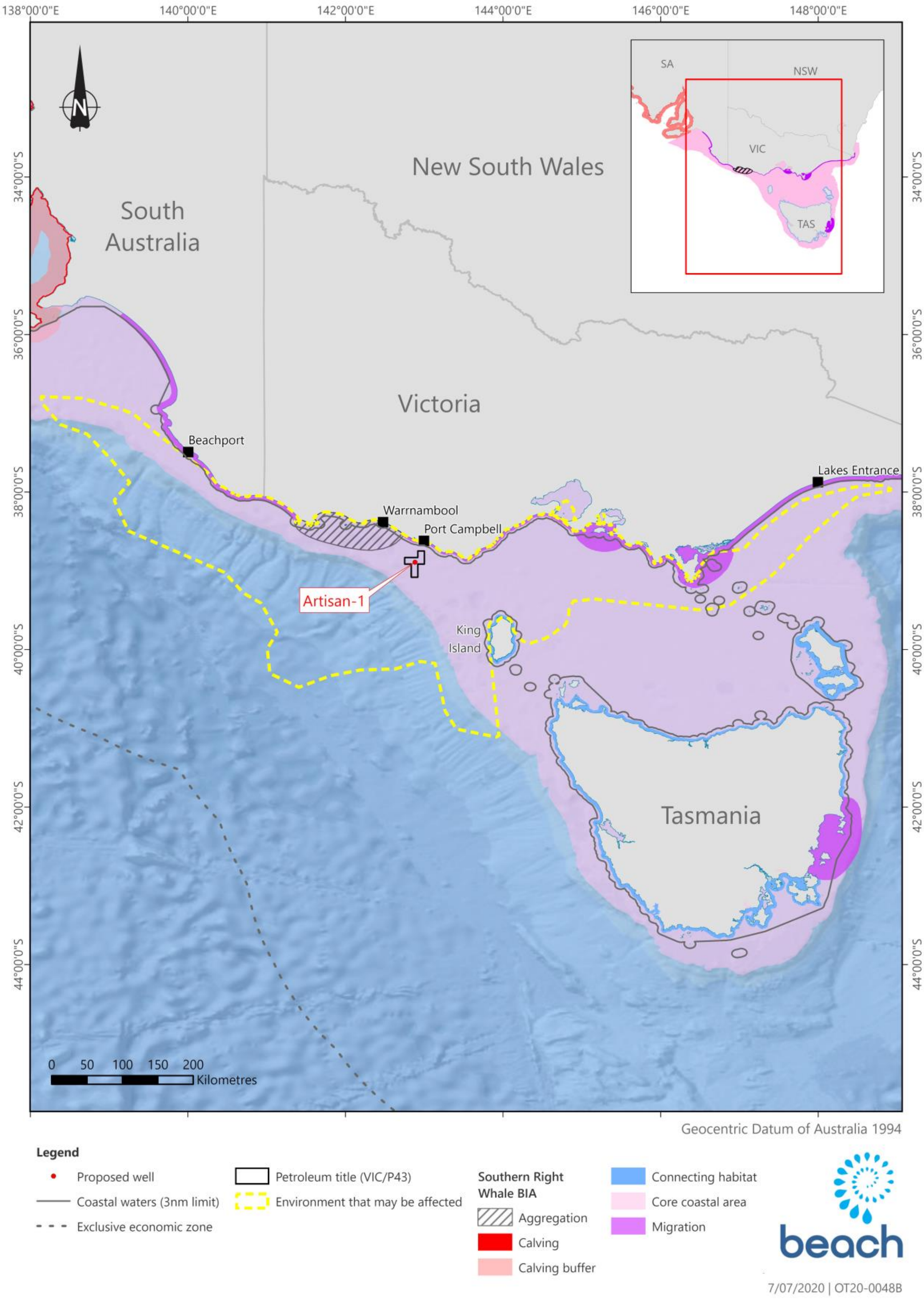


Figure 5-34: Southern right whale BIAs within the spill EMBA

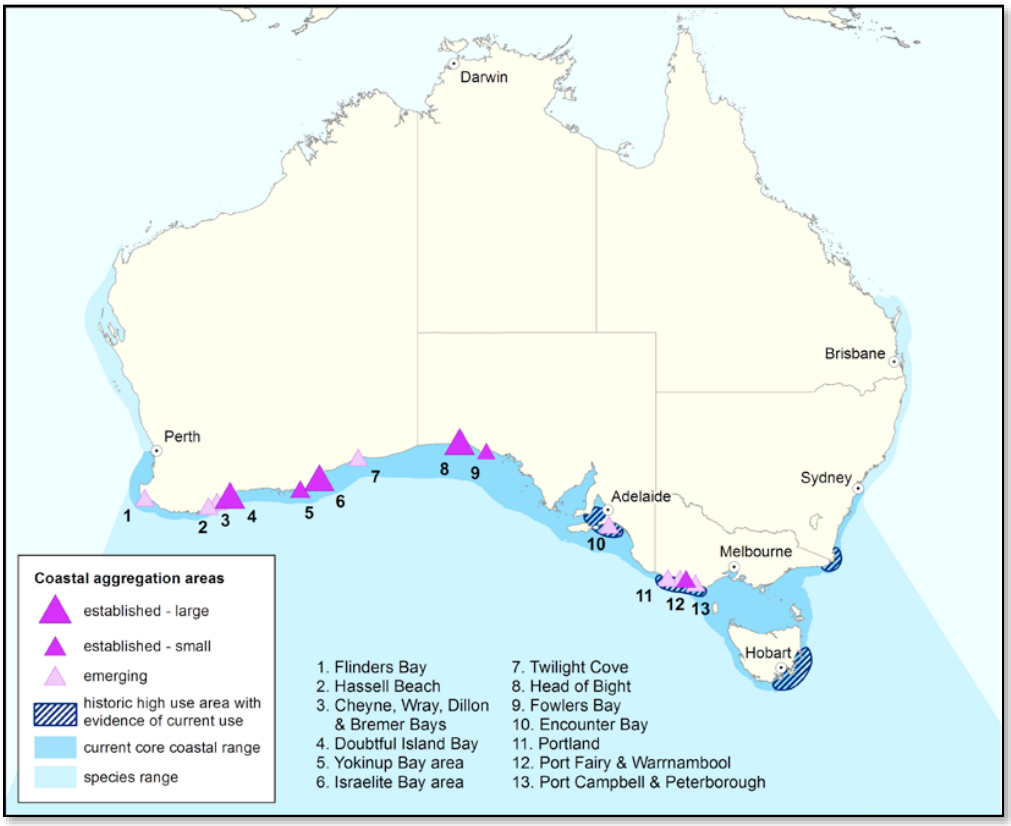


Figure 5-35: Aggregation areas for southern right whales (DSEWPaC, 2012

Humpback whale

Humpback whales (*Megaptera novaeangliae*) are present around the Australian coast in winter and spring. Humpbacks undertake an annual migration between the summer feeding grounds in Antarctica to their winter breeding and calving grounds in northern tropical waters. Along the southeast coast of Australia, the northern migration starts in April and May while the southern migration peaks around November and December (TSSC, 2015a). A discrete population of humpback whales have been observed to migrate along the west coast of Tasmania and through Bass Strait, and these animals may pass through the operational area. The exact timing of the migration period varies between years in accordance with variations in water temperature, extent of sea ice, abundance of prey, and location of feeding grounds (TSSC, 2015a). Feeding occurs where there is a high krill density, and during the migration this primarily occurs in Southern Ocean waters south of 55°S (TSSC, 2015a).

Humpback whales satellite-tagged off Australia's east coast were tracked during three austral summers in 2008/2009, 2009/2010 and 2010/2011 (Andrews-Goff et al., 2018). Of the thirty tagged humpbacks, 21 migrated south along the coastline across into Bass Strait during October. In November the whales then migrated along the east coast (12 whales) and west coast (1 whale) of Tasmania to Antarctic feeding grounds. The state space model used shows both search and transit behaviour revealing new temperate feeding grounds in Bass Strait, the east coast of Tasmania and in the eastern Tasman Sea.

There is no known feeding, resting or calving grounds for humpback whales in the operational area or EMBAs, although feeding may occur opportunistically where sufficient krill density is present (Commonwealth of Australia, 2015). The nearest BIA which is important habitat for migrating humpback whales is Twofold Bay, a resting area off the NSW coast (Commonwealth of Australia, 2015a).

During Origin's Enterprise 3D seismic survey undertaken during early November 2014, 16 humpback whales were sighted (RPS, 2014).

The recovery of humpback whale populations following whaling has been rapid. The Australian east coast humpback whale population, which was hunted to near-extinction in the 1950s and early 1960s, had increased to 7,090±660 (95% CI) whales by 2004 with an annual rate of increase of 10.6±0.5% (95% CI) between 1987–2004 (Noad et al., 2011). The available estimates for the global population total more than 60,000 animals, and global population is categorised on the IUCN Red List as Least Concern.

Sei whale

Sei whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. They show well defined migratory movements between polar, temperate and tropical waters. Migratory movements are essentially north-south with little longitudinal dispersion. Sei whales do not penetrate the polar waters as far as the blue, fin, humpback and minke whales (Horwood, 1987), although they have been observed very close to the Antarctic continent.

Sei whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for sei whales in Australian waters.

Sei whales feed intensively between the Antarctic and subtropical convergences and mature animals may also feed in higher latitudes. Sei whales feed on planktonic crustaceans, in particular copepods and amphipods. Below the Antarctic convergence sei whales feed exclusively upon Antarctic krill (*Euphausia superba*).

In the Australian region, sei whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978; Bannister et al., 1996; Thiele et al., 2000; Chatto and Warneke 2000; Bannister 2008a).

Sightings of sei whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al., 2012), where opportunistic feeding has been observed between November and May (Gill et al., 2015).).

There are no known mating or calving areas in Australian waters. The sei whale is likely to be an uncommon visitor to the operational area and EMBAs.

Fin whale

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

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

Fin whales were sighted, and feeding was observed between November-May (upwelling season) during aerial surveys conducted between 2002-2013 in South Australia (Gill et al., 2015). This is one of the first documented records these whales feeding in Australian waters, suggesting that the region may be used for opportunistic baleen whale feeding (Gill et al., 2015). Fin whales have also been acoustically detected south of Portland, Victoria (Erbe et al., 2016). Aulich et al. (2019) recorded infrequent presence of fin whales in Portland between 2009 to

2016. This suggests that the area may not be a define migratory route however, calls recorded in July may be from whales migrating northward towards the east coast of NSW. Calls detected in late August and September may be indication of the presence of whales on their migration route back to Antarctica waters.

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

As there are no BIAs for the fin whale in the operational area or EMBAs, they are likely to be uncommon visitors to the operational area and EMBAs.

Pygmy right whale

The pygmy right whale (*Caperea marginata*) is a little-studied baleen whale species that is found in temperate and sub-Antarctic waters in oceanic and inshore locations. The species, which has never been hunted commercially, is thought to have a circumpolar distribution in the Southern Hemisphere between about 30°S and 55°S. Distribution appears limited by the surface water temperature as they are almost always found in waters with temperatures ranging from 5° to 20°C (Baker, 1985) and staying north of the Antarctic Convergence. There are few confirmed sightings of pygmy right whales at sea (Reilly et al., 2008). The largest reported group was sighted (100+) just south-west of Portland in June 2007 (Gill et al., 2008).

Species distribution in Australia is found close to coastal upwellings and further offshore it appears that the Subtropical Convergence may be important for regulating distribution (Bannister et al., 1996). Key locations include south-east Tasmania, Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to upwelling habitats rich in marine life and zooplankton upon which it feeds (Bannister et al., 1996).

The pygmy right whale has been observed in surveys in the region however Origin Energy did not observe it during the 2010 Speculant MSS and 2014 Enterprise MSS. Also, there are no BIAs identified in the operational area or EMBAs. Therefore, it is likely to be an uncommon visitor in the operational area and EMBAs.

Killer whale

Killer whales (*Orcinus orca*) are thought to be the most cosmopolitan of all cetaceans and appear to be more common in cold, deep waters; however, they have often been observed along the continental slope and shelf particularly near seal colonies (Bannister et al., 1996). The killer whale is widely distributed from polar to equatorial regions and has been recorded in all Australian waters with concentrations around Tasmania. The only recognised key locality in Australia is Macquarie Island and Heard Island in the Southern Ocean (Bannister et al., 1996). The habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters (DotEE, 2019d).

Killer whales are top-level carnivores. Their diet varies seasonally and regionally. The specific diet of Australian killer whales is not known, but there are reports of attacks on dolphins, young humpback whales, blue whales, sperm whales, dugongs and Australian sea lions (Bannister et al., 1996). In Victoria, sightings peak in June/July, where they have been observed feeding on sharks, sunfish, and Australian fur seals (Morrice et al., 2004; Mustoe, 2008).

The breeding season is variable, and the species moves seasonally to areas of food supply (Bannister et al., 1996; Morrice et al., 2004). Killer whales are frequently present in Victorian waters with sightings recorded along most of Victoria's coastline. Mustoe (2008) describes between 2002 and 2008 web-based casual sightings had an average of 13 killer whales sighted per year in Victoria and NSW, more than half in Victorian waters. This combined with the Atlas of Victorian Wildlife indicates a peak in killer whale sightings in June to July and September to November (Mustoe, 2008).

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

Minke whale

The minke whale (*Balaenoptera acutorostrata*) is a widely distributed baleen whale that has been recorded in all Australian waters except the Northern Territory. The whales can be found inshore although they generally prefer deeper waters. In summer they are abundant feeding throughout the Antarctic south of 60°S but appear to migrate to tropical breeding grounds between 10°S and 20°S during the Southern Hemisphere winter (Kasamatru, 1998; Reilly et al., 2008). Although the exact location of breeding grounds is unknown, mating occurs between August to September with calving between May and July (Bannister et al., 1996). A few animals have been sighted during aerial surveys of the Bonney coast upwelling. The minke whale has been observed within the region however there are no BIAs in the operational area or EMBAs. Therefore, it is likely that they would be uncommon visitors in the operational area and EMBAs.

Antarctic minke whale

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

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

Long-finned pilot whale

The long-finned pilot whale (*Globicephala melas*) is distributed throughout the northern and southern hemispheres in circumpolar oceanic temperate and subantarctic waters containing zones of higher productivity along the continental slope. They sometimes venture into the shallower waters of the shelf (<200 m) in pursuit of prey species. Stomach contents confirm that squid are the main prey of long-finned pilot whales in Australian waters, although some fish are also taken (DotEE, 2019f). No key localities have been identified in Australia (Bannister et al., 1996) however they are considered reasonably abundant (DotEE, 2019f).

There is some (inconclusive) evidence that suggests the species moves along the edge of the continental shelf in southern Australian waters (Bannister et al., 1996) in response to prey abundance at bathymetric upper slopes and canyons (DoE, 2016g). Records from Tasmania indicate mating occurs in spring and summer with 85% of calves born between September and March although births do occur throughout the year.

No calving areas are known in Australian waters (DotEE, 2019f).

The long-finned pilot whale has been identified in surveys over the Bass Strait and eastern Great Australian Bight; however, there are no BIAs in the operational area or EMBAs. During works undertaken by Origin Energy, long-finned pilot whales have been seen sporadically, such as, a sighting of approximately 30 whales occurred during the 2014 Enterprise MSS. It is likely that they would be uncommon visitors in to the operational area and EMBAs.

Sperm whale

The sperm whale (*Physeter macrocephalus*) has a worldwide distribution and has been recorded in all Australian states. Sperm whales tend to inhabit offshore areas with a water depth of 600 m or greater and are uncommon in waters less than 300 m deep (DotEE, 2019f). Key locations for the species include the area between Cape Leeuwin to Esperance (WA); southwest of Kangaroo Island (SA), deep waters of the Tasmanian west and south coasts, areas off southern NSW (e.g., Wollongong) and Stradbroke Island (Qld) (DotEE, 2019f). Concentrations of sperm whales are generally found where seabeds rise steeply from a great depth (i.e., submarine canyons at the edge of the continental shelf) associated with concentrations of food such as cephalopods (DotEE, 2019f).

Females and young males are restricted to warmer waters (i.e., north of 45oS) and are likely to be resident in tropical and sub-tropical waters year-round. Adult males are found in colder waters and to the edge of the Antarctic pack ice. In southern Western Australian waters sperm whales move westward during the year. For species in oceanic waters, there is a more generalised movement of sperm whales' southwards in summer and northwards in winter (DotEE, 2019f).

Sperm whales are prolonged and deep divers often diving for over 60 minutes (Bannister et al., 1996) however studies have observed sperm whales do rest at, or just below, surface for extended periods (>1 hr) (Gannier et al., 2002). In addition, female and juvenile sperm whales in temperate waters have been observed to spend several hours a day at surface resting or socialising (Hastie et al., 2003).

The sperm whale has been observed in the region, however the closest recognised BIA for foraging is further east near Kangaroo Island in South Australia. Therefore, it is likely they would be uncommon visitors in the operational area and EMBAs.

Southern right whale dolphin

The southern right whale dolphin (*Lissodelphis peronnii*) is a pelagic species found in Southern Australian waters but generally well offshore in deep water or on the outer edges of the continental shelf between the subtropical and subantarctic convergence (DotEE, 2019h). No key localities have been identified in Australian waters however preferred water temperatures range from approximately 2-20°C (DotEE, 2019h). Of the limited southern right whale dolphin stomachs examined, myctophids and other mesopelagic fish, squid and crustaceans have been recorded, and euphausiids are also thought to be potential prey (DotEE, 2019h). It is unknown whether the southern right whale dolphin is a surface or deep-layer feeder (Bannister et al., 1996).

Calving areas are not known, however there is evidence that the calving season occurs between November to April (DotEE, 2019h).

The southern right whale dolphin has been observed in the region; however, no BIAs have been identified in the operational area or EMBAs. Therefore, it is likely they would be uncommon visitors in the operational area and EMBAs.

Dusky dolphin

The dusky dolphin (*Lagenorhynchus obscures*) is rare in Australian waters and has been primarily reported across southern Australia from Western Australia to Tasmania with a handful of confirmed sightings near Kangaroo Island and off Tasmania (DotEE, 2019i). Only 13 reports of the dusky dolphin have been made in Australia since 1828, and key locations are yet to be identified (Bannister et al., 1996). The species is primarily found from approximately 55°S to 26°S, though sometimes further north associated with cold currents. They are considered to be primarily an inshore species but can also be oceanic when cold currents are present (DotEE, 2019i).

Bottlenose dolphin

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

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

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

The bottlenose dolphin has been observed in the region; however, no BIAs have been identified in the operational area or EMBAs. Therefore, it is likely they would be uncommon visitors in the operational area and EMBAs.

Common dolphin

The common dolphin (*Delphinus delphis*) is an abundant species, widely distributed from tropical to cool temperate waters, and generally further offshore than the bottlenose dolphin, although small groups may venture close to the coast and enter bays and inlets. They have been recorded in waters off all Australian states and territories. Stranding statistics indicate that common dolphins are active in Bass Strait at all times of the year, though less so in winter (DotEE, 2019k).

Common dolphins are usually found in areas where surface water temperatures are between 10°C and 20°C, and in habitats also inhabited by small epipelagic fishes such as anchovies and sardines.

In many areas around the world common dolphins show shifts in distribution and abundance, suggesting seasonal migration. The reason for this seasonal migration is unknown however in New Zealand the shift appears to be correlated with sea surface temperature and in South Africa, the species occurrence appears to be correlated with the annual sardine run (DotEE, 2019k). They are abundant in the Bonney coast upwelling during the upwelling season, and very scarce outside the season.

Risso's dolphin

The Risso's dolphin (*Grampus griseus*) is a widely distributed species found in deep waters of the continental slop and outer shelf from the tropics to temperate regions. The species prefer warm temperate to tropical waters with depths greater than 1,000 m, although they do sometimes extend their range into cooler latitudes in summer (Bannister et al., 1996). They are thought to feed on cephalopods, molluscs and fish. The Risso's dolphin has been observed in the region, however no BIAs have been identified in the operational area or EMBAs. Therefore, it is likely they would be uncommon visitors in the operational area and EMBAs.

Indian Ocean bottlenose dolphin

The Indian Ocean bottlenose dolphins are found in tropical and sub-tropical coastal and shallow offshore waters of the Indian Ocean, Indo-Pacific Region and the western Pacific Ocean bottlenose dolphins are distributed continuously around the Australian mainland, but the taxonomic status of many populations is unknown. Indian Ocean bottlenose dolphins have been confirmed to occur in estuarine and coastal waters of eastern, western and northern Australia and it has also been suggested that the species occurs in southern Australia (Kemper, 2004).

In south-eastern Australia, inshore Indian Ocean bottlenose dolphins show a high degree of site fidelity to some local areas and appear to belong to relatively small communities or populations (Möller et al., 2002).

5.7.7.7 Pinnipeds

The PMST reports identified three pinnipeds that potentially occur in the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs (Appendix A). The spill EMBA overlaps a foraging BIA for the Australian sea lion.

Table 5-19: Listed pinniped species identified in the PMST search

Common name	**Species name**	**EPBC Act status**			**Likely presence**
		Listed threatened	**Listed migratory**	**Listed marine**	
New Zealand fur-seal	*Arctocephalus forsteri*	-	-	L	SHM
Australian fur-seal	*Arctocephalus pusillus*	-	-	L	BK
Australian sea lion	*Neophoca cinerea*	V	-	L	SHK

Listed Threatened
V: Vulnerable
Listed Marine
L: Listed

Likely Presence
SHM: Species or species habitat may occur within area.
SHK: Species or species habitat known to occur within area.
BK: Breeding known to occur within area

Australian sea lion

The Australian sea lion is the only endemic, and least abundant, pinniped that breeds in Australia (DoE, 2013b). All current breeding populations are outside of the 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 5-36). The Australian sea lion is a specialised benthic forager; i.e. it feeds primarily on the sea floor (DSEWPaC, 2013). The Australian sea lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC, 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC, 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy, 1999).

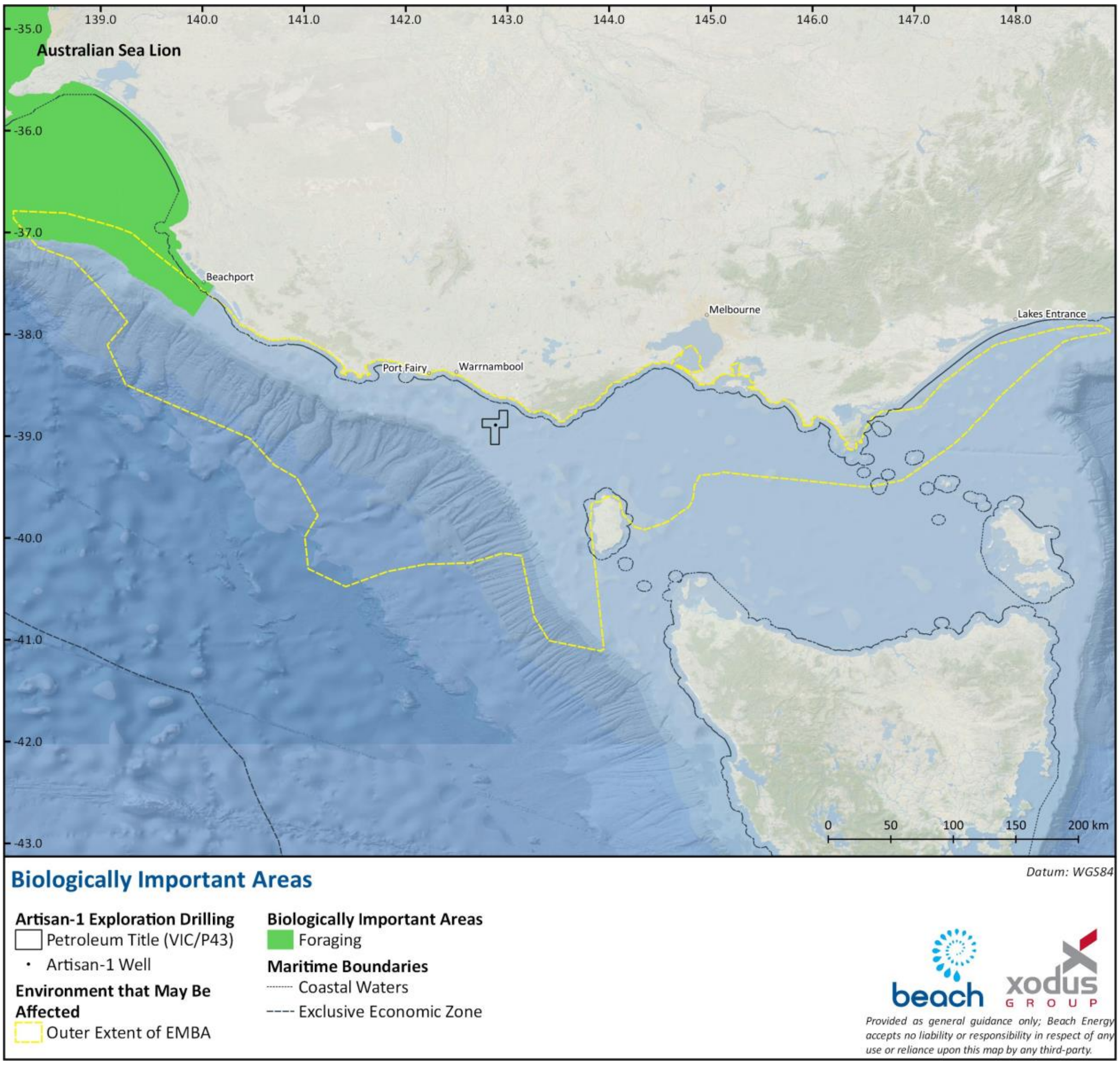


Figure 5-36: Australian sea lion foraging BIA

New Zealand fur-seal

New Zealand fur-seal (*Arctocephalus forsteri*) are found in the coastal waters and offshore islands of South and Western Australia, Victoria, NSW and New Zealand. Population studies for New Zealand fur-seal in Australia carried out in 1990 estimated an increasing population of about 35,000. The species breeds in southern Australia at the Pages Islands and Kangaroo Island, which produces about 75% of the total pups in Australia. Small populations are established in Victorian coastal waters including at Cape Bridgewater near Portland, Lady Julia Percy Island near Port Fairy, Kanowna Island (near Wilsons Promontory) and The Skerries in eastern Victoria.

Figure 5-37 illustrates the current and historic distribution of New Zealand fur-seal colonies (Kirkwood et al., 2009). These colonies are typically found in rocky habitat with jumbled boulders. Colonies are typically occupied year-round, with greater activity during breeding seasons. Pups are born from mid-November to January, with most pups born in December (Goldsworthy, 2008). Known sites for New Zealand Fur-seal breeding colonies within the spill EMBA include Lady Julia Percy Island, Seal Rocks, Kent Group Islands, Kanowa Island and Cape Bridgewater (Figure 5-29).

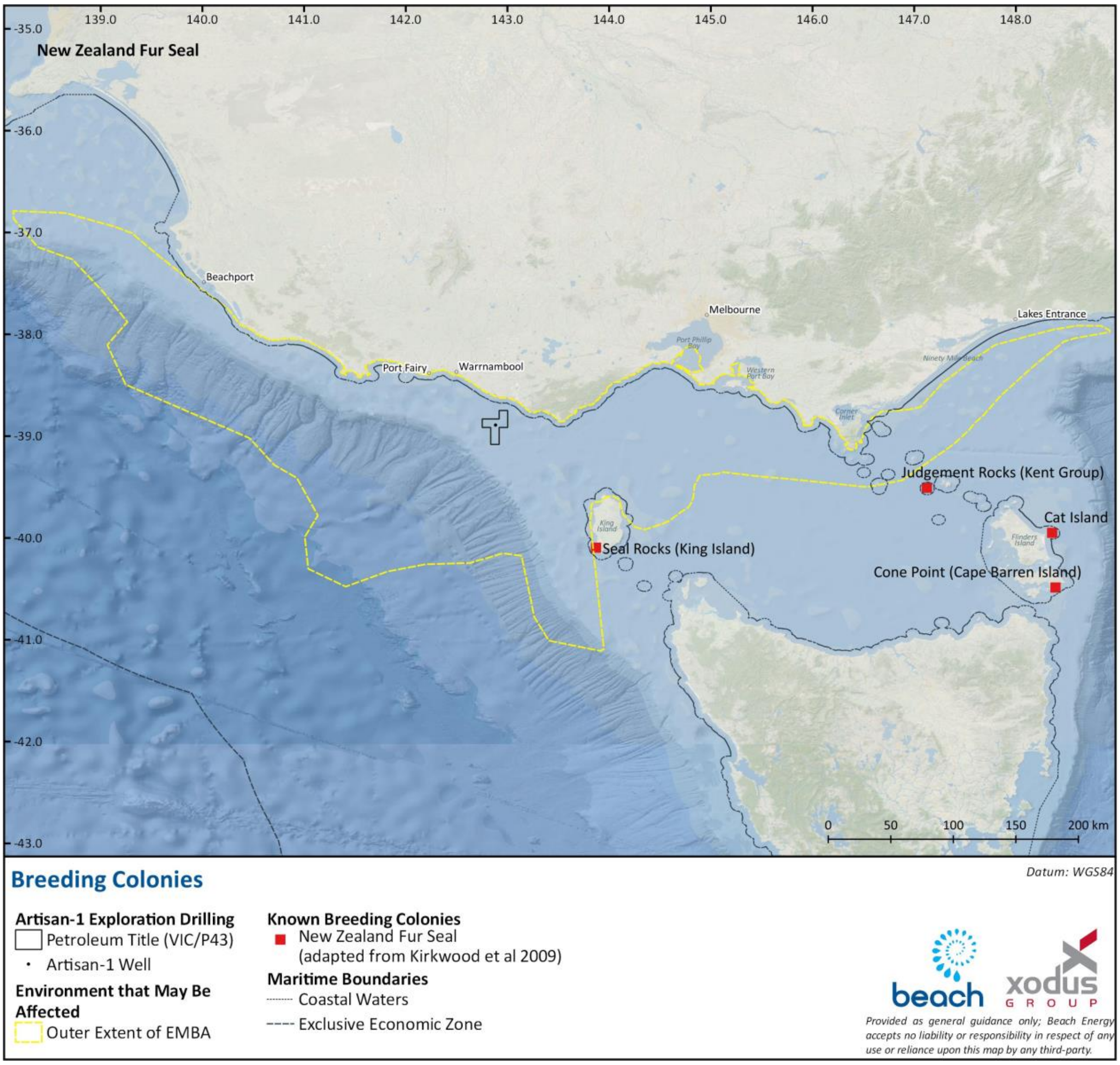


Figure 5-37: Locations of New Zealand fur-seal breeding colonies (Kirkwood et al., 2009).

Australian fur-seal

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

In Victorian State waters they breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland (Figure 5-38). There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. Their preferred breeding habitat is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

Haul out sites with occasional pup births are located at Cape Bridgewater, at Moonlight Head, on various small islands off Wilsons Promontory and Marengo Reef near Apollo Bay. Australian fur-seals are present in the region all year, with breeding taking place during November and December.

Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al., 2008; Hume et al., 2004; Arnould & Kirkwood, 2007).

During the summer months, Australian fur-seals travel between northern Bass Strait islands and southern Tasmania waters following the Tasmanian east coast, however, lactating female fur-seals and some territorial males are restricted to foraging ranges within Bass Strait waters. Lactating female Australian fur-seals forage primarily within the shallow continental shelf of Bass Strait and Otway on the benthos at depths of between 60 – 80 m and generally within 100 – 200 km of the breeding colony for up to five days at a time.

Male Australian fur-seals are bound to colonies during the breeding season from late October to late December, and outside of this they time forage further afield (up to several hundred kilometres) and are away for long periods, even up to nine days (Kirkwood et al., 2009; Hume et al., 2004).

As there are breeding and haul out sites within the spill EMBA it is likely that Australian fur-seal would be present in the spill EMBA.

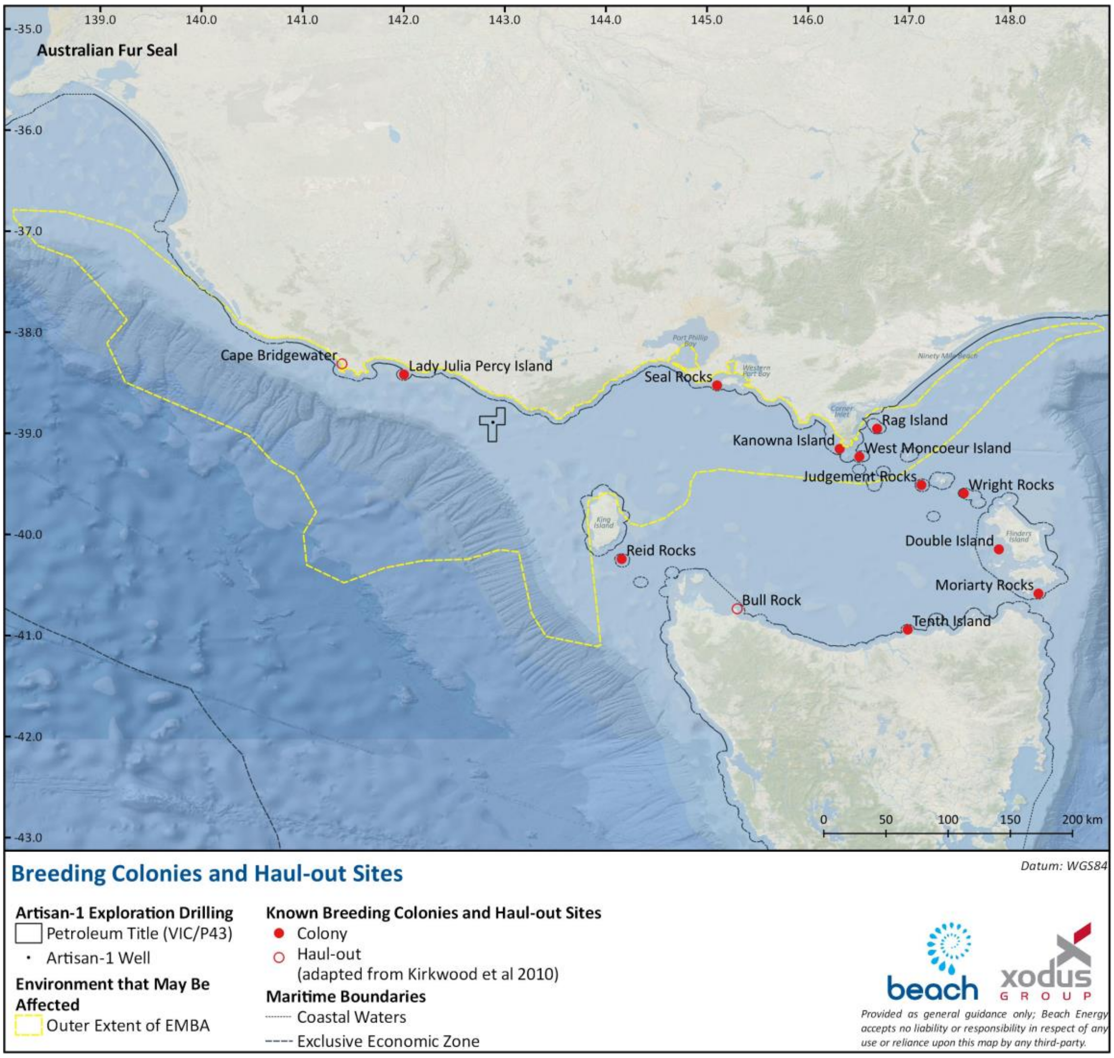


Figure 5-38: Locations of Australian fur-seal breeding colonies and haul out sites (Kirkwood et al., 2010)

5.7.8 Invasive/introduced marine species

5.7.8.1 Pest species

Invasive marine species (IMS) are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish. More than 200 non-indigenous marine species including fish, molluscs, worms and a toxic alga have been detected in Australian coastal waters.

It is widely recognised that IMS can become pests and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati & Grosholz, 2006).

In the South-east Marine Region, 115 marine pest species have been introduced and an additional 84 have been identified as possible introductions, or 'cryptogenic' species (NOO, 2002). Several introduced species have become pests either by displacing native species, dominating habitats or causing algal blooms.

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

- northern pacific sea star (Asterias amurensis);
- fan worms (Sabella spallanzannii and Euchone sp);
- bivalves (Crassostrea gigas (Pacific oyster) Corbulagibba and Theorafragilis);
- crabs (Carcinus maenas (European shore crab) and Pyromaia tuberculata);
- macroalgae (Undaria pinnatifida (Japanese giant kelp) and Codium fragile tormentosoides; and
- the introduced New Zealand screw shell (Maoricolpus roseus).

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

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

5.7.8.2 Viruses

A virus, the Abalone Viral Ganglioneuritis (AVG), has been detected in wild abalone populations in southwest Victoria and was confirmed as far east as White Cliffs near Johanna, and west as far as Discovery Bay Marine Park (DPI, 2012). The virus can be spread through direct contact, through the water column without contact, and in mucus that infected abalone produce before dying. The last confirmation of active disease in Victoria was from Cape Otway lighthouse in December 2009 (Victoria State Government, 2016).

Strict quarantine controls need to be observed with diving or fishing activities in south-west Victoria when the virus has been detected in the area. Given the lack of detected AVG in Victorian State waters, controls outlined in the Biosecurity Control Measures for AVG: A Code of Practice (Gavine et al., 2009) are not active.

5.8 Socio-economic environment

This section describes the socio-economic environment within the operational area, light and noise behaviour, noise 24 hr, waste water and spill EMBAs.

5.8.1 Coastal settlements

Coastal settlements only occur along the coast of the spill EMBA.

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

The largest settlement within the spill EMBA is Mornington Peninsula, with a population just under 300,000 (Table 5-20). The Warrnambool, Peterborough, Childers Cove, Bay of Islands, Port Campbell, Princetown, Moonlight Head, Cape Otway, Apollo Bay, Cape Patton, Lorne and Anglesea settlements are along the Great Ocean Road, a National Heritage listed stretch along the Victorian coastline, with Warrnambool marking the western end. Warrnambool is another large settlement within the spill EMBA, with a population just under 30,000 (Table 5-20) and is a former port for the state of Victoria. The Port of Warrnambool has a breakwater and yacht club and provides shelter for commercial fishing boats. Portland and Port Fairy are the next largest centres with populations of 9,712 and 3,340, respectively (Table 5-20). Portland is Victoria's western-most commercial port and is a deep-water port with breakwaters sheltering a marina and boat ramp. Port Fairy has both harbour and fish processing facilities, but is not suitable for use by large vessels, nor is Port Campbell.

The coastal settlements within the spill EMBA all provide services to the commercial and recreational fishing industries in south-west Victoria and rely on fishing and tourism to contribute to their economies through income and employment. In Portland and Princetown, the largest employment industries are the agriculture, forestry and fishing industries, accounting for 59 and 28%, respectively (Table 5-20). In all but the two largest centres, accommodation and food services (which are heavily reliant on tourism) is either the first or second largest employment industry (Table 5-20).

Table 5-20: Coastal settlement population estimates and employment figures

Settlement	Population[1]	% of employment in industries relevant to potential impacts[2]	
		Agriculture, forestry & fishing	Accommodation & food services
Discovery Bay	N/A	N/A	N/A
Cape Nelson	N/A	N/A	N/A
Portland	9,712	2.8	8.8
Port Fairy	3,340	6.5	12.8
Warrnambool	29,661	2.1	9.1
Peterborough	247	6.7	13.3

Settlement	Population[1]	% of employment in industries relevant to potential impacts[2]	
		Agriculture, forestry & fishing	Accommodation & food services
Childers Cove	N/A	N/A	N/A
Bay of Islands	N/A	N/A	N/A
Port Campbell	478	28.4	16.6
Princetown	241	59.3	10.5
Moonlight Head	N/A	N/A	N/A
Cape Otway	15	N/A	N/A
Apollo Bay	1,598	3.6	27.9
Cape Patton	N/A	N/A	N/A
Lorne	1,114	0	0
Anglesea	2,545	0	4.8
Torquay	13,258	0	0
Port Phillip	100,872	0	0
Mornington Peninsula	289,142	0	0
Western Port	N/A	N/A	N/A
French Island	119	N/A	N/A
Kilcunda	396	0	0
Venus Bay	944	0	0
Cape Liptrap	N/A	N/A	N/A
Waratah Bay	56	N/A	N/A
Wilsons Promontory	13	N/A	N/A
Corner Inlet	N/A	N/A	N/A
Eurobodalla (NSW)	92	N/A	N/A

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

5.8.2 Petroleum exploration

Petroleum exploration has been undertaken within the Otway Basin since the early 1960s. Gas reserves of approximately 2 trillion cubic feet (tcf) have been discovered in the offshore Otway Basin since 1995, with production from five gas fields using 700 km of offshore and onshore pipeline. Up to 2015, the DEDJTR reports that 23 PJ of liquid hydrocarbons (primarily condensate) has been produced from its onshore and offshore basins, with 65 PJ remaining, while 85 PJ of gas has been produced (Victoria and South Australia), with 1,292 PJ remaining.

As Beach is the Titleholder of Permit VIC/P43, Beach can confirm that no additional petroleum activities are planned within the operational area during Artisan-1 exploration drilling.

From a review of the NOPSEMA website and engagement with other oil and gas exploration companies a summary of exploration activities that may occur within the Otway Basin within the same time period as Artisan-1 drilling activities are detailed in Table 5-21. There is no overlap of petroleum activities with the Artisan-1 operational area with the activities identified.

Table 5-21: Petroleum exploration potentially within the operational area

Titleholder	Activity	Timing and Duration	Proximity to Artisan-1 exploration well
Spectrum Geo Australia Pty Ltd	Otway Deep Marine Seismic Survey	October 2019 – end February 2020 120 days	Figure 5-39 shows the Spectrum acquisition area is 35 km from the Artisan-1 well. Based on information on the NOPSEMA website the survey period is for October 2019 to 28 February 2020 which does not overlap the Artisan-1 well timing period.
Schlumberger Australia Pty Ltd	Otway Basin 2DMC Marine Seismic Survey	November 2019 – June 2020 100 days	Figure 5-39 shows that the closest 2D seismic line to the Artisan-1 well is 17 km. Based on information on the NOPSEMA website the survey period is for November – June 2020 which does not overlap the Artisan-1 well timing period.
3D Oil T49P Pty Ltd	Dorrigo 3D Marine Seismic Survey	1 September - 31 October 2019 35 days	Figure 5-39 shows the Dorrigo 3D Marine Seismic Survey acquisition area is over 60 km from the Artisan-1 well. Based on information on the NOPSEMA website the survey period is for 1 September - 31 October 2019 which does not overlap the Artisan-1 well timing period.

5.8.3 Petroleum production

There is no non-Beach oil and gas infrastructure within the operational area, light and noise behaviour, noise 24 hr and waste water EMBAs. The Cooper Energy Casino and Henry gas fields and Casino-Henry pipeline and the Minerva gas field and pipeline are within the northern portion of the spill EMBA (Figure 5-41).

5.8.4 Shipping

The SEMR is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes (Figure 5-40). Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania.

Ports Australia (2019) provide statistics for port operations throughout Australia's main commercial ports. Based on the latest information (2018 – 2019 financial year) the majority of commercial shipping traffic transiting to and from Victorian ports were bulk liquid carriers (696,261), bulk gas (445,230),other cargo (3,800), container (1,057), general cargo (716), car carrier (384) and livestock (36).

5.8.5 Tourism

Consultation has identified that the key areas of tourism in the region include land-based sightseeing from the Great Ocean Road and lookouts along that road, helicopter sightseeing, private and chartered vessels touring into the Twelve Apostles Marine Park, diving and fishing. Land-based tourism in the region peaks over holiday periods and in 2011, Tourism Victoria reported a total of approximately 8 million visitors to the Great Ocean Road region.

Local vessels accessing the area generally launch from Boat Bay in the Bay of Islands or from Port Campbell. Given the available boat launching facilities in the area (Peterborough and Port Campbell), and the prevailing sea-state of the area, vessel-based tourism is limited.

5.8.6 Recreational diving

Recreational diving occurs along the Otway coastline. Popular diving sites near Peterborough include several shipwrecks such as the Newfield, which lies in 6 m of water and the Schomberg in 8 m of water. Peterborough provides several good shore dives at Wild Dog Cove, Massacre Bay, Crofts Bay and the Bay of Islands. In addition, there is the wreck of the Falls of Halladale (4-11 m of water) which can be accessed from shore or via boat.

Consultation with local vessel charterers and providers of SCUBA tank fills has confirmed that diving activity is generally concentrated around The Arches Marine Sanctuary and the wreck sites of the Loch Ard and sometimes at the Newfield and Schomberg shipwrecks. Diving activity peaks during the rock lobster season with the bulk of recreational boats accessing the area launching from Boat Bay at the Bay of Islands or Port Campbell.

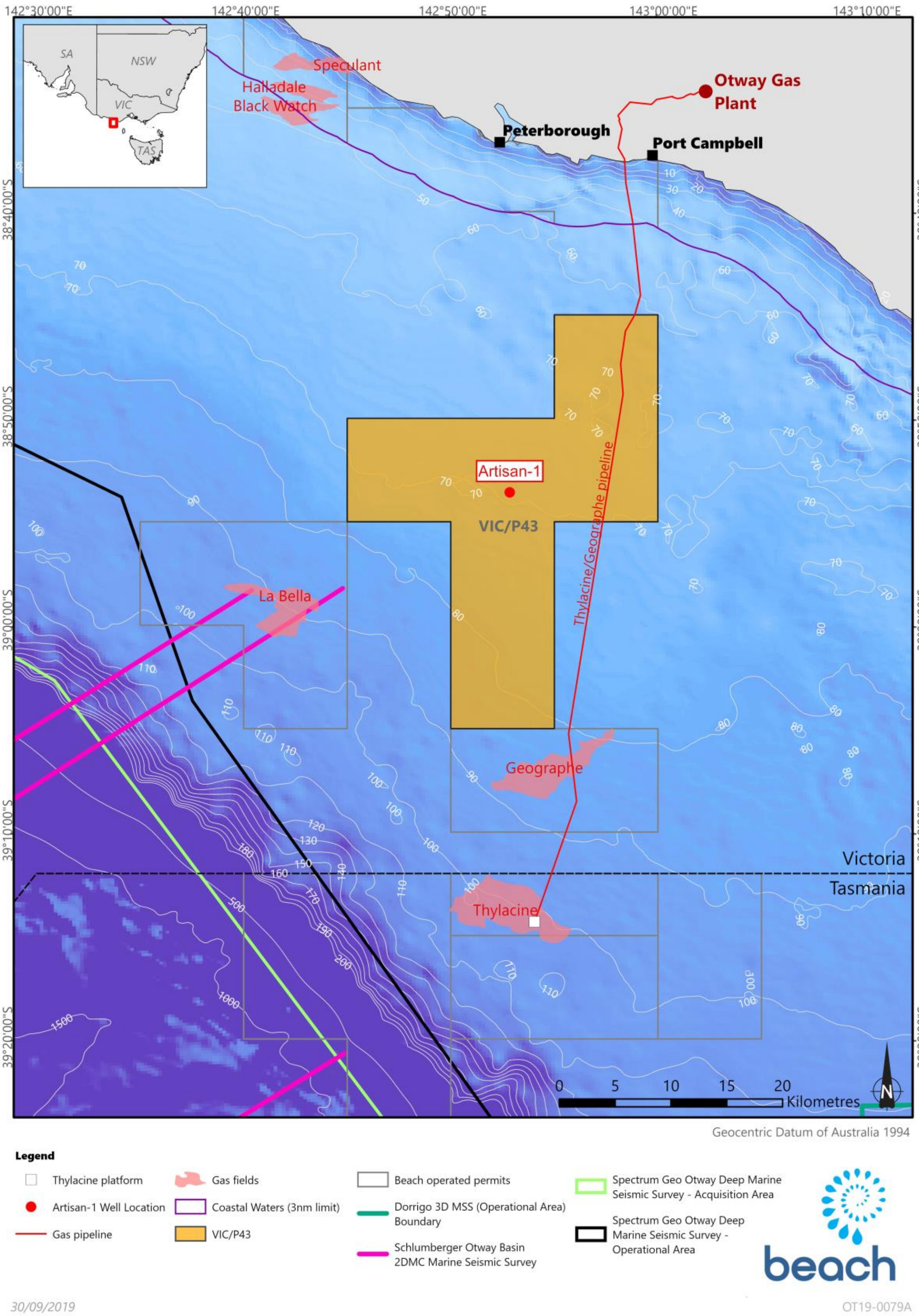


Figure 5-39: Oil and gas exploration activities

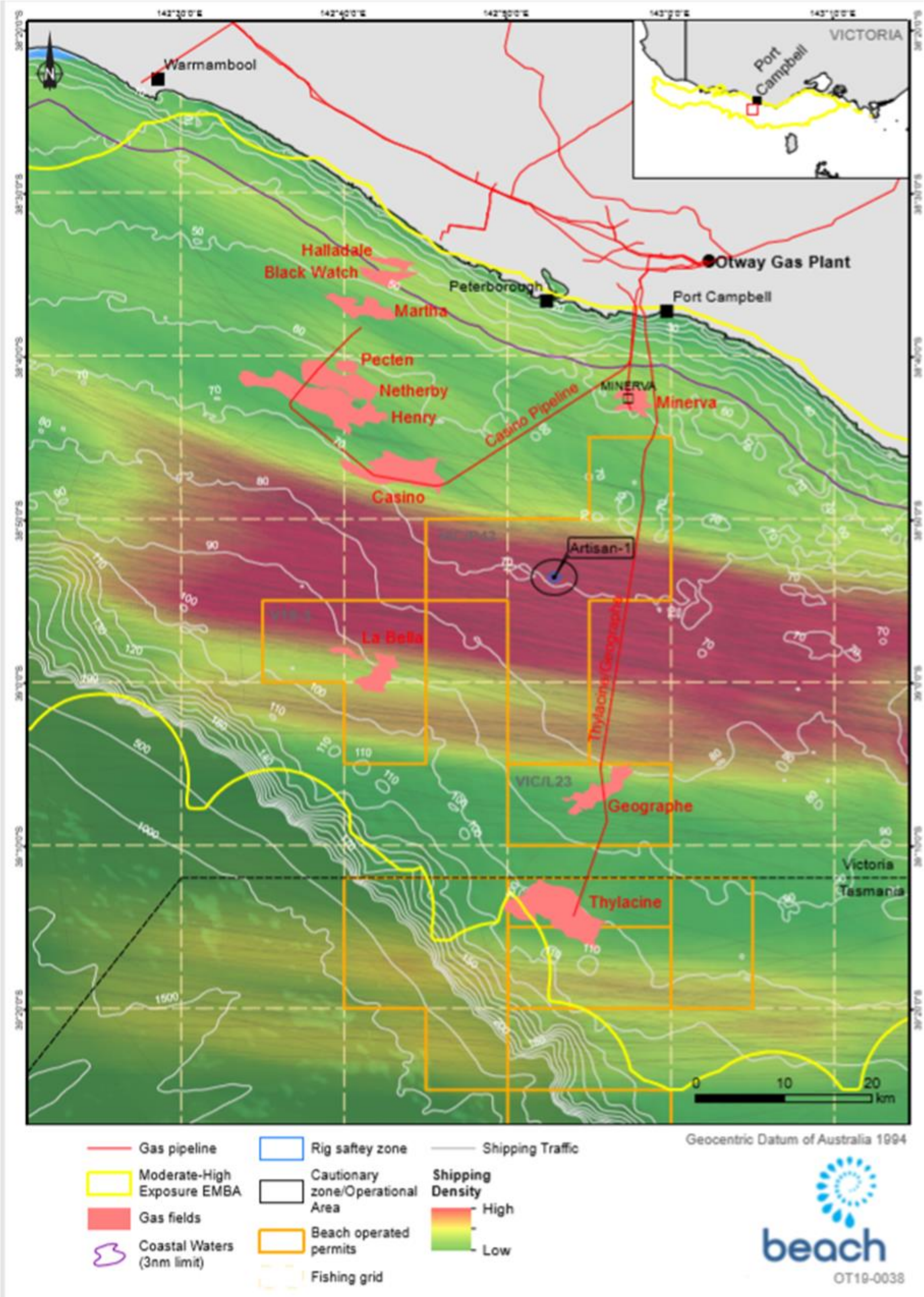


Figure 5-40: Shipping intensity

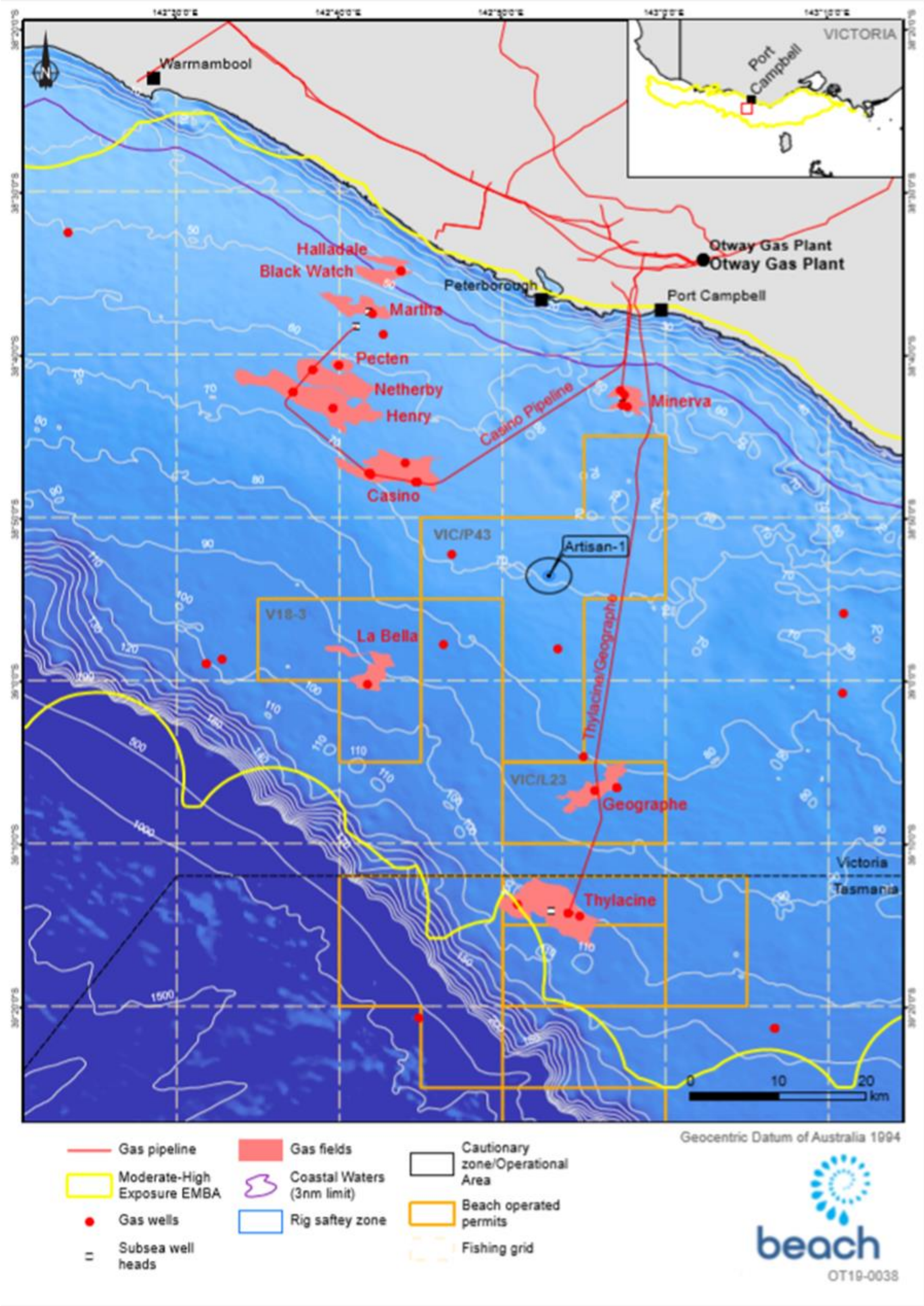


Figure 5-41: Oil and gas infrastructure

5.8.7 Commonwealth managed fisheries

A review of the AFMA website identified that the following Commonwealth managed fisheries overlap the spill EMBA:

- Bass Strait Central Zone Scallop Fishery (Bass Strait CZSF)
- Eastern Tuna and Billfish Fishery (ETBF)
- Skipjack Tuna Fishery
- Small Pelagic Fishery (SPF)
- Southern Bluefin Tuna Fishery (SBTF)
- Southern and Eastern Scalefish and Shark Fishery (SESSF)
- Southern Squid Jig Fishery.

Of these fisheries, the Bass Strait Central Zone Scallop Fishery, ETBF, SBTF, SESSF and Southern Squid Jig Fishery have catch effort within the spill EMBA and SESSF and Southern Squid Jig Fishery have catch effort within the operational area based on ABARES reports 2014 – 2019 (Patterson et al. 2018, 2017, 2016, 2015 and Georgeson et al. 2014). The Skipjack Fishery is not currently active and management arrangements for the fishery are under review.

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in Table 5-22.

Engagement with AFMA was undertaken in relation to providing licensing information for any Commonwealth fishers who are active within the Beach Otway development operational area which includes the Artisan-1 operational area. AFMA replied that currently no vessels are active within the operational area (Stakeholder Record AFMA 02).

Table 5-22: Commonwealth managed fisheries within the spill EMBA

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Bass Strait Central Zone Scallop Fishery	Scallops	Fishery operates in the Bass Strait between the Victorian and Tasmanian and starts at 20 nm from their respective coastlines. Fishing effort is concentrated around King and Flinders Islands. Currently 12 active boats using towed dredges. Fishing season is 1 April to 31 December. Actual catch in 2018 was 3,253 tonnes. The major landing ports in Victoria are Apollo Bay and Queenscliff. Total fishery value in 2017 was A$6.7 million. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the spill EMBA based on ABARES data 2013 – 2018. There has been no fishing effort in the operational area based on ABARES data 2013 – 2018.	No	Yes
Eastern Tuna and Billfish Fishery	Albacore tuna Bigeye tuna Yellowfin tuna Broadbill swordfish Striped marlin	A longline and minor line fishery that operates in water depths > 200 m from Cape York to Victoria. Fishery effort is typically concentrated along the NSW coast and southern Queensland coast. No Victorian ports are used. In 2017 there was some fishing effort in Victoria at low levels and no fishing effort in 2018. The number of active vessels has decreased within the fishery from around 150 in 2002 to 40 in 2018. Actual catch in the 2018 season was 4,046 tonnes. Total fishery value in 2017-18 was A$38.4 million. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort within the spill EMBA based on ABARES data 2013 – 2018. There has been no fishing effort in the operational area based on ABARES data 2013 – 2018.	No	Yes
Skipjack Tuna Fishery (Eastern)	Skipjack tuna	The Skipjack Tuna Fishery is not currently active and the management arrangements for this fishery are under review. There has been no catch effort in this fishery since the 2008 -2009 season.	No	No

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Small Pelagic Fishery (Western sub-area)	Jack mackerel Blue mackerel Redbait Australian sardine	The Small Pelagic Fishery extends from the southern Queensland to southern Western Australia. Fishers use midwater trawls and purse seine nets. Geelong is a major landing port. Total retained catch of the four target species was 5713 tonnes in the 2017-18 season. Fishery effort generally concentrated in the near-shore Great Australian Bight to the west and south of Port Lincoln. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been no fishing effort in the spill EMBA based on ABARES data 2013 – 2018. There has been no fishing effort in the operational area based on ABARES data 2013 – 2018.	No	No

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Southern and Eastern Scalefish and Shark Fishery (SESSF) (Commonwealth Trawl Sector and Scalefish Hook Sector)	Blue-eye trevalla Blue grenadier Blue warehou Deepwater sharks Eastern school whiting Flathead Gemfish Gulper shark Jackass morwong John dory Mirror dory Ocean jacket Ocean perch Orange roughy Smooth oreodory Pink ling Red fish Ribaldo Royal red prawn Silver trevally Silver warehou	The Southern and Eastern Scalefish and Shark Fishery stretches south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern Western Australia. The spill EMBA is within the Commonwealth Trawl Sector and Scalefish Hook Sector. A multi-sector, multi-species fishery that uses a range of gear year-round. Fishing is generally concentrated along the 200 m bathymetric contour. Total retained catch of the target species was 8,631 tonnes in the 2017-18 season. In 2016-17, the fishery value was A$46.4 million. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the spill EMBA based on ABARES data 2013 – 2018. There has been fishing effort in the operational area based on ABARES data 2013 – 2018.	Yes	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Southern Bluefin Tuna Fishery	Southern bluefin tuna	The Southern Bluefin Tuna Fishery covers the entire sea area around Australia, out to 200 nm from the coast. Southern bluefin tuna are also commonly caught off the NSW coastline. In this area, fishers catch these fish using the longline fishing method. A pelagic longline and purse seine fishery that was worth $38.6 million in 2016-17 (actual catch was 5334 tonnes). The fishery operates year-round. Fishery effort is generally concentrated in the Great Australian Bight and off the southern NSW coast. Fishing mortality: not subject to overfishing. Biomass: Over fished. There has been fishing effort within the spill EMBA in 2017 based on ABARES data 2013 – 2018. There has been no fishing effort in the operational area based on ABARES data 2013 – 2018.	No	Yes
Southern Squid Jig Fishery	Gould's squid (arrow squid)	A single species fishery that operates year-round. Portland and Queenscliff are the major Victorian landing ports. Fishing effort is generally concentrated along the 200 m bathymetric contour with highest fishing intensity south of Portland and Warrnambool. In 2016-17, the actual catch of 828 tonnes was worth A$2.24 million. In 2016-17 there were eight active vessels in the fishery. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the spill EMBA based on ABARES data 2013 – 2018. There has been fishing effort in the operational area based on ABARES data 2013 – 2018.	Yes	Yes

Data/information sources: Australian Fisheries Management Authority (www.afma.gov.au), ABARES Fishery Status Reports 2014 to 2019.

5.8.8 Victorian managed fisheries

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

- Rock Lobster Fishery;
- Giant Crab Fishery;
- Abalone Fishery;
- Scallop (Ocean) Fishery;
- Wrasse (Ocean) Fishery; and
- Snapper Fishery.

A description of these fisheries is detailed in Table 5-23.

Monthly catch data by fishery grid area for each species with catch (t) and number of fishers was obtained from the Victorian Fisheries Association (VFA) for the period of 2014 – 2018. Data was requested from VFA for the following grids within the EMBA:

- J10; J11; J12
- K10; K11; K12
- L10; L11; L12

The operational area is within grid J12.

From the data obtained from the VFA it was identified that only the rock lobster and giant crab fisheries have catch effort within the grids. This aligns with data obtained from VFA (www.vfa.vic.gov.au) and detailed in Table 5-24 and Table 5-25.

For the Giant Crab Fishery, the data shows:

- there has been no catch effort in grid J12 which the operational area overlaps.
- for the other grids there has been a maximum of one fisher for the months that fishing effort occurred within a grid.

For the Rock Lobster Fishery, the data shows:

- there has been catch effort in grid J12 which the operational area overlaps.
- catch effort within the grid J12 has been a maximum of one fisher for the months that fishing effort occurred.
- for the other grids there has been a maximum of one fisher for the months that fishing effort occurred within a grid.

Table 5-23: Victorian managed fisheries in the EMBA

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort spill EMBA
Rock Lobster Fishery (western zone)	Southern rock lobster	Victoria's second most valuable fishery with a production value of A$24 million in 2014-15. Since 2009/10, annual quotas have been set at between 230 and 260 tonnes and have been fully caught each year. In the western zone, most catch is landed through Portland, Port Fairy, Warrnambool, Port Campbell and Apollo Bay. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) lobsters. Southern rock lobsters are found to depths of 150 m, with most of the catch coming from inshore waters less than 100 m deep. Fishing data from VFA for 2014 – 2018 identified that there is fishing effort within the spill EMBA and operational area. Based on information from SIV approximately 40 t of southern rock lobster has been caught within the grids for which data was provided for over the last 10 years. This equates to between 1.5 – 1.7% of the total catch over the 10-year period.	Yes	Yes
Giant Crab Fishery	Giant crab	A small fishery operating in western Victoria and closely linked with the Rock Lobster Fishery. Most vessels are used primarily for rock lobster fishing with giant crab taken as by-product. Fishing effort is concentrated on continental shelf edge (~200 m deep). Giant crabs inhabit the continental slope at approximately 200 m depth and are most abundant along the narrow band of the shelf edge. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) giant crabs. Total landed catch in 2015-16 was 10 tonnes. Fishing data from VFA for 2014 – 2018 identified that there is fishing effort within the spill EMBA but not within the operational area. Based on information from SIV approximately 18 t of giant crab has been caught within the operational area of the last 10 years. The total catch over the last 10 years has been 157.8 t so 18 t equates to This equates to 11% of the total catch being caught in the operational area.	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort spill EMBA
Abalone Fishery (western zone)	Blacklip abalone Greenlip abalone	A highly valuable fishery (A$20 million in 2014-15) that operates along most of the Victorian shoreline, generally to 30 m depth. Abalone are harvested by divers. Total allowable commercial catch limits of blacklip abalone for the western zone are considerably less than the central and eastern zone (for 2017-18 season, 63.2 tonnes compared with 274.0 and 352.5 tonnes, respectively). There are 14 licences in the western zone. The water depths where abalone are fished are close to shore within the spill EMBA. No fishing effort was identified in the operational area.	No	Yes
Scallop (Ocean) Fishery	Scallops	Extends the length of the Victorian coastline from high tide mark to 20 nm offshore. Fishers use a scallop dredge. Temporary closures occur when stocks are low to allow scallop beds to recover. Total allowable commercial catch for 2015-16 was set at 135 tonnes. Scallops are mostly fished from Lakes Entrance and Welshpool. Fishing data from VFA for 2014 – 2018 did not identify scallop fishing effort within the grids provided which include the operational area. Based on the fishery location scallop fishing effort may occur within the spill EMBA.	No	Yes
Wrasse (Ocean) Fishery	Bluethroat wrasse Purple wrasse Small catches of rosy wrasse, senator wrasse and southern Maori wrasse	Extends the length of the Victorian coastline from high tide mark to 20 nm offshore. Fishers mostly use hook and line. Limited entry fishery with 22 current licences. Total annual catches in 2014-15 and 2015-16 were ~30 tonnes. Fishing data from VFA for 2014 – 2018 did not identify wrasse fishing effort within the grids provided which include the operational area. Based on the fishery location wrasse fishing effort may occur within the spill EMBA.	No	Yes
Snapper Fishery (western stock) (Ocean fishery trawl (inshore) licence)	Snapper	Snapper are caught using lines, nets and haul seine. Over 90% of the catch is from Port Phillip Bay, and around 5% from coastal waters. In 2014-15, 147 tonnes were landed at a value of A$1.38 million. Fishing data from VFA for 2014 – 2018 did not identify snapper fishing effort within the grids provided which include the operational area. Based on the fishery location snapper fishing effort may occur within the spill EMBA.	No	Yes

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

Table 5-24: Giant Crab Fishery fisher per grid per month from 2014 to 2018

Month	J10	La Bella K10	La Bella and umbilical route K11	Geographe and umbilical route K12	L10	Thylacine L11	Thylacine L12
Jan 2014		1					
Feb 2014		1					
Dec 2014		1				1	
Jan 2015		1					
Feb 2015			1				
Nov 2015						1	
Dec 2015	1	1				1	
Jan 2016						1	
Mar 2016						1	
Apr 2016						1	
May 2016		1					
Mar 2017		1				1	
Apr 2017		1				1	
May 2017		1			1	1	
Jun 2017		1			1		
Aug 2017						1	1
Jan 2018						1	
May 2018						1	1
Jun 2018							1
Aug 2018				1			
Dec 2018		1					1

Note: Data only shows those months where there was fishing effort

Table 5-25: Rock Lobster Fishery fisher per grid per month from 2014 to 2018

Month	J10	La Bella and flowline route J11	Artisan, flowline and umbilical route J12	La Bella K10	La Bella and umbilical route K11	Geographe and umbilical route K12	L10	Thylacine L11	Thylacine L12
Jan 2014	1	1		1					
Feb 2014	1	1		2	1				
Mar 2014			1						
Jul 2014			1						
Aug 2014					1	1			
Sep 2014	1	1							
Dec 2014	1				1				
Jan 2015			1	1	1				
Feb 2015	1				1	1			
Apr 2015	1				1				1
May 2015	1								
Dec 2015	1			1					
Jan 2016								1	
Feb 2016	1			1					
Mar 2016			1	1		1			
Apr 2016			1		1	1		1	
May 2016	1								
Feb 2017						1			
Mar 2017						1			

Month	J10	La Bella and flowline route J11	Artisan, flowline and umbilical route J12	La Bella K10	La Bella and umbilical route K11	Geographe and umbilical route K12	L10	Thylacine L11	Thylacine L12
Apr 2017	1								
May 2017			1						
Jun 2017			1				1		
Aug 2017						1			1
Dec 2017	1								
Feb 2018	1		1						
Aug 2018	1		1			2			
Sep 2018			1		1	1			
Dec 2018	1			1					

Note: Data only shows those months where there was fishing effort

5.8.9 Tasmanian managed fisheries

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

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

A description of these fisheries is in Table 5-26. No Tasmanian fisheries where identified within the operational area.

The jurisdiction of all eight Tasmanian state managed fisheries intersects with the spill EMBA. Historic catch assessments indicate that Commercial Dive, Scallop and Shellfish Fisheries activities are unlikely to occur in the spill EMBA, with fishing effort located in other areas of these fisheries. The Rock Lobster and Abalone Fisheries, which are by far the most productive and economically important Tasmanian fisheries accounting for 95% of the total value, are both expected to be active within the spill EMBA. Giant Crab, Scalefish, Scallop and Seaweed Fisheries are also likely to be active within the spill EMBA to varying degrees.

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

Table 5-26: Tasmanian managed fisheries in the EMBA

Fishery	Target species	Description	Fishing Effort EMBA
Abalone Fishery (Northern and Bass Strait Zones)	Black lip (*Haliotis rubra*) and greenlip abalone (*H. laevigata*)	Largest wild abalone fishery in the world (providing ~25% of global production) and a major contributor to the local economy. Abalone are hand-captured by divers in depths between 5-30 m. Blacklip abalone are collected around on rocky substrate around the Tasmanian shoreline and are the main focus of the fishery. Greenlip abalone are distributed along the north coast and around the Bass Strait islands and usually account for around 5% of the total wild harvest. Total landings were 1561 t for 2017, comprising 1421 t of blacklip and 140 t of greenlip abalone. Production value was approximately $70 million. The spill EMBA intersects the Northern Zone (waters around King Island) and Bass Strait Zone (waters in the Northern Bass Strait Region) of the Abalone Fishery.	Yes
Commercial Dive Fishery (Northern Zone)	White sea urchin (*Heliocidaris urethrograms*), black sea urchin (*Centrostephanus rodgersii*) and periwinkles (*Lunella undulate*)	Dive capture fishery that targets several different species; the main species collected being sea urchins and periwinkles. In 2010-2011 (the most recent period for which information was available) approximately 100 t of sea urchins and 15 t of periwinkles were harvested, and the fishery had a total commercial value of around $250,000. Sea urchins and periwinkles accounting for 63% and 37% of the total respectively. Jurisdiction encompasses all Tasmanian State waters (excluding protected and research areas), although licence holders largely operate out of small vessels (<10 m) and effort is concentrated on the south and east costs of Tasmania around ports. The spill EMBA intersects the Northern Zone of the Commercial Dive Fishery at King Island and in the northern Bass Strait. The Northern Zone of the fishery is defined as the area of Tasmanian State waters on the east coast bounded by the line of latitude 42°20'40"S in the south and extending north to the line of latitude 41°00'26"S (from the southern point of Cape Sonnerat to Red Rocks).	Yes
Giant Crab Fishery	Giant crab (*Pseudocarcinus gigas*)	The giant crab fishery is a comparatively small fishery with the annual harvest set at 46.6 tonnes but with a high landed value of around $2 million. The fishery has been commercially targeted since the early 1990s moving from open access to limited entry. The area of the fishery includes waters surrounding the state of Tasmania generally south of $39^{o}12$ out to 200 nm. Within the area of the fishery, most effort takes place on the edge of the continental slope in water depths between 140 m and 270 m. CPUE has declined continually since the inception of the fishery in the early 1990s indicating that it has been overfished. The TAC has been reduced to 20.7 t for 2017/18 and 2019/2020 to address the issue. The spill EMBA potentially overlaps the area where giant crabs are fished for on the continental slope.	Yes

Fishery	Target species	Description	Fishing Effort EMBA
Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*)	Southern rock lobster are the other major wild-caught Tasmanian fishery. For 2019-20 the Total Allowable Catch has remained at 1220.7 t which includes the Total Allowable Recreational Catch (TARC) of 170 tonnes and the Total Allowable Commercial Catch (TACC) of 1050.7 tonnes or 100 kg per unit for the 2019-20 season. Rock lobster made up a volume of 1,047 t or 25% percent of total fisheries production in 2015/16. Production value was $89 million or 51% of total fisheries value in 2014/15 (up 7% from 2013/14). Southern rock lobsters are found to depths of 150 m with most of the catch coming from inshore waters less than 100 m deep throughout state waters. There are 209 vessels active in the fishery. The spill EMBA potentially overlaps the Rock Lobster Fishery.	Yes
Scalefish Fishery (northwest coast)	Numerous species, but the majority of effort is on # species	Complex multi-species fishery harvesting a range of scalefish, shark and cephalopod species. Fourteen different fishing methods are used. The total catch was around 270 t in 2014/15, a decline of 20 t compared to the previous season. The highest landings of finfish include wrasse (81 t), southern calamari (76 t), flathead (36 t), southern garfish (34 t), banded morwong (30 t) and Australian salmon (23 t). The spill EMBA potentially overlaps the Scalefish Fishery.	Yes
Scallop Fishery	Commercial scallop (*Pecten fumatus*)	Fishery area extends 20 nm from the high water mark of Tasmanian state waters into Bass Strait and out to 200 nm offshore from the remainder of the Tasmanian coastline. Eight vessels are active in the fishery. Fishers use a scallop dredge. Scallop beds are generally found along the east coast and Bass Strait in depths between 10-20 m but may occur in water deeper than 40 m in the Bass Strait. Scallop habitat is protected through a ban on dredging in waters less than 20 m and a network of dredge-prohibited areas around the state. There is high variability in abundance, growth, mortality, meat yield and condition of scallop stock in the fishery and recruitment is sporadic and intermittent. Managed using an adaptable strategy where surveys are undertaken to estimate abundance and decision rules are used to open an area (or areas) to fishing. When open the scallop fishery contributes significantly to total fisheries production. In 2015 the scallop fishing season ran from July to October and the catch was 781 t. At present the Tasmanian Commercial Scallop fishery remains closed. The spill EMBA does not overlap the area of effort for the Scallop Fishery.	No

Fishery	Target species	Description	Fishing Effort EMBA
Seaweed Fishery	Bull kelp (*Durvillea Pototorum*), Japanese kelp (*Undaria pinnatifida*)	Components of this fishery include collection of cast bull kelp and harvesting of Japanese kelp, an introduced species. The majority of cast bull kelp is collected from King Island. The right to harvest and process kelp on King Island was granted exclusively to Kelp Industries Pty Ltd in the mid-1970s. About 80 to 100 individuals collect cast bull kelp and transport it to the Kelp Industries plant in Currie. An average annual harvest above 3000 t (dried weight) has been produced in recent years, accounting for about 5% of the world production of alginates (i.e. the end product of dried bull kelp). The cast bull kelp harvesting on King Island generates about $2 million annually. Comparatively minor cast bull kelp collection also occurs at two centres of operation on Tasmania's West Coast: around Bluff Hill Point and at Granville Harbour. Japanese kelp is harvested by divers only along Tasmania's east coast where it is already well established. The spill EMBA potentially overlaps the Seaweed Fishery.	Yes
Shellfish Fishery	Katelysia cockles (*Katelysia scalarina*), Venerupis clam (*Venerupis largillierti*), native oyster (*Ostrea angasi*), Pacific oyster (*Crassostrea gigas*)	Comprises specific shellfish species hand captured by divers in defined locations on the east coast of Tasmania, namely Angasi oysters in Georges Bay, Venerupis clams in Georges Bay and Katelysia cockles in Ansons Bay. The taking of Pacific oysters, an invasive species, is also managed as part of the fishery but no zones apply. Pacific oysters can be collected throughout all State waters (which includes areas within the spill EMBA), as the aim of harvesting these animals is to deplete the wild population. The estimated total value of the shellfish fishery based on landings from 2001-2005 was $345,538. The spill EMBA does not overlap the Shellfish Fishery.	No

Data/information sources: Department of Primary Industries, Water and Environment (DPIPWE, 2015). Australian fisheries and aquaculture statistics 2014-15 (Patterson et al, 2016), Department of the Environment and Energy (DotEE, 2017c), Fish Research and Development Corporation (FRDC, 2017)

5.9 Cultural environment

5.9.1 Maritime archaeological heritage

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

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

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

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* (DoE, 2016q, 2016r; DELWP, 2016b). 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 (DoE, 2016q, 2016r; DTPLI, 2015) but outside the spill EMBA.

There are over 200 historic wrecks in the spill EMBA. Only one of these wrecks, the *SS Alert*, has a protection zone that is within the EMBA.

There is no identified aircraft wreckage within the EMBAs.

5.9.2 Aboriginal heritage

Aboriginal groups inhabited the southwest Victorian coast as is evident from the terrestrial sites of Aboriginal archaeological significance throughout the area. During recent ice age periods (the last ending approximately 12,000-14,000 years ago), sea levels were significantly lower, and the coastline was a significant distance seaward of its present location, enabling occupation and travel across land that is now submerged.

Coastal Aboriginal heritage sites include mostly shell middens, some stone artefacts, a few staircases cut into the coastal cliffs, and at least one burial site. The various shell middens within the Port Campbell National Park and Bay of Islands Costal Park are close to coastal access points that are, in some cases, now visitor access points (Parks Victoria, 2006b).

Aboriginal people have inhabited Tasmania for at least 35,000 years. At the end of the last ice age the sea level rose, and Tasmania became isolated from the mainland of Australia. They survived in the changing landscape partly due to their ability to harvest aquatic resources, such as seals and shellfish.

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

5.9.3 Native title

A search of the National Native Title Tribunal (NNTT) database identifies two claims have been accepted for registration over the adjacent coastal shoreline (and terrestrial component of the spill EMBA). One claim is by the Eastern Maar people (VC2012/001), registered in 2013, and extends seaward 100 m from the mean low-water mark of the coastline (NNTT, 2016). There is currently no determination registered over the area of the claim (still active) in the National Native Title Register. There is also a registered claim (2014/001) over Wilson’s Promontory by the Gunaikurnai people. There are no registered claims in Tasmania.

6 Environmental Impact and Risk Assessment Methodology

6.1 Overview

This section outlines the environmental impact and risk assessment methodology used for the assessment of the program activities. The methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, *Risk Management – Principles and Guidelines*). Figure 6-1 outlines this risk assessment process.

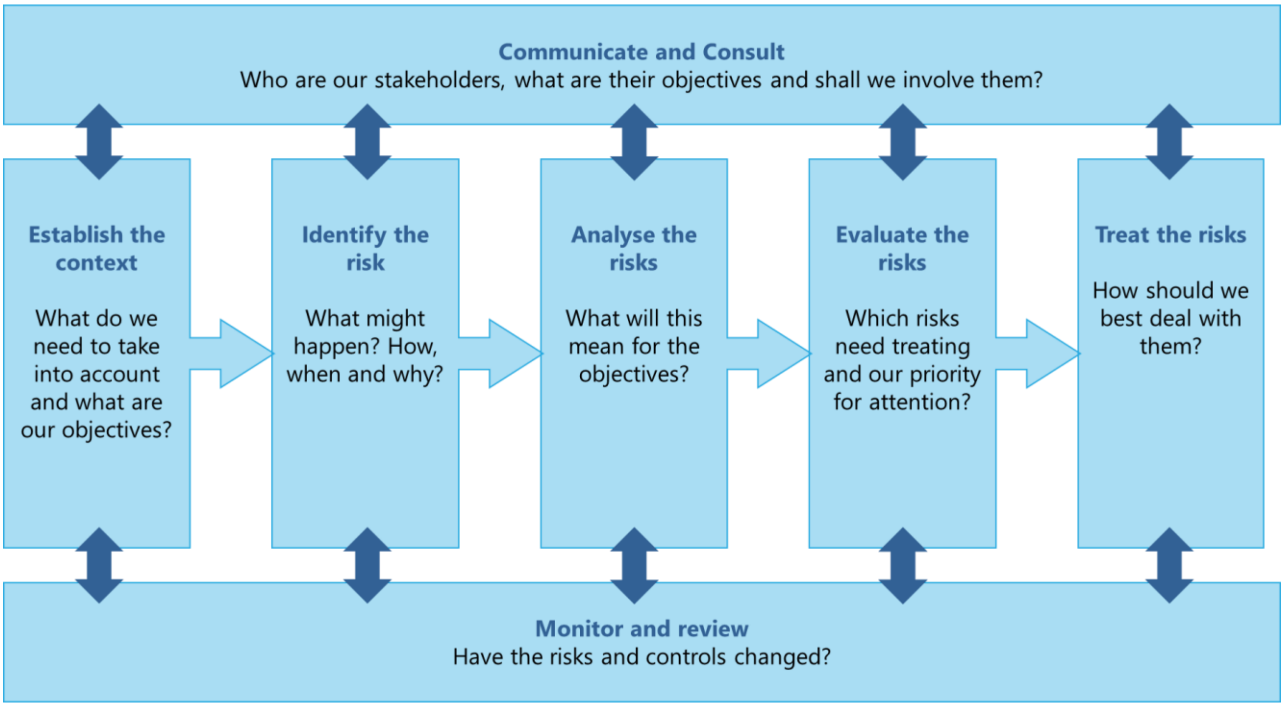


Figure 6-1: Risk assessment process

6.1.1 Definitions

Definitions of the term used in the risk assessment process are detailed in Table 6-1.

Table 6-1: Risk assessment process definitions

Term	Definition
Activity	Refers to a 'petroleum activity' as defined under the OPGGS(E)R as: • petroleum activity means operations or works in an offshore area undertaken for the purpose of: a. exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or, b. discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act.
Consequence	The consequence of an environmental impact is the potential outcome of the event on affected receptors (particular values and sensitivities). Consequence can be positive or negative.
Control measure	Defined under the OPGGS(E)R as a system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks.
Emergency condition	An unplanned event that has the potential to cause significant environmental damage or harm to MNES. An environmental emergency condition may, or may not, correspond with a safety incident considered to be a Major Accident Event.
Environmental aspect	An element or characteristic of an operation, product, or service that interacts or can interact with the environment. Environmental aspects can cause environmental impacts.
Environmental impact	Defined under the OPGGS(E)R as any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.
Environmental performance outcome	Defined under the OPGGS(E)R as a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
Environmental performance standard	Defined under the OPGGS(E)R as a statement of the performance required of a control measure.
Environmental risk	An unplanned environmental impact has the potential to occur, due either directly or indirectly from undertaking the activity.
Likelihood	The chance of an environmental risk occurring.
Measurement criteria	A verifiable mechanism for determining control measures are performing as required.
Residual risk	The risk remaining after control measures have been applied (i.e. after risk treatment).

6.2 Communicate and consult

In alignment with Regulation 11A(2) of the OPGGS(E)R, during the development of this EP, Beach has consulted with relevant person(s) (stakeholders) to obtain information in relation to their activities within the operational area and potential impacts to their activities. This information is used to inform the EP and the risk assessment undertaken for the activity. Stakeholder consultation is an iterative process that continues throughout the development of the EP and for the duration of a petroleum activity as detailed in Section 9.

6.3 Establish the context

Context for the risk assessment process is established by:

- understanding the regulatory framework in which the activity takes place (described in Section 3, 'Applicable Requirements');
- identifying the environmental aspects of the activity (and associated operations) that will or may cause environmental impacts or may present risks to the environment (based upon the 'Activity Description' in Section 4);
- identifying the environment that may be affected, either directly or indirectly, by the activity (based upon the 'Existing Environment' as described in Section 5); and
- understanding the concerns of stakeholders and incorporating those concerns into the design of the activity where appropriate (outlined in Section 9, 'Stakeholder Consultation').

6.4 Identify the potential impacts and risks

Potential impacts (planned) and risks (unplanned) associated with the environmental aspects of the activity are identified in relation to the EMBA, either directly or indirectly, by one or multiple aspects of the activity i.e., identifying the cause-effect pathway by which environmental and social receptors may be impacted. Table 7-1 details the aspects identified for the activity.

6.5 Analyse the potential impacts and risks

Once impacts and risks have been identified, an analysis of the nature and scale of the impact or risk is undertaken. This involves determining the possible contributing factors associated with the impact or risk. Each possible cause should be identified separately, particularly where controls to manage the risk differ. In this way, the controls can be directly linked to the impact or risk.

6.5.1 Establish environmental performance outcomes

Environmental performance outcomes (EPOs) are developed to provide a measurable level of performance for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level. EPOs have been developed based on the following:

- ecological receptors: MNES: Significant Guidelines 1.1 to identify the relevant significant impact criteria. The highest category for the listed threatened species or ecological communities likely to be present within the EMBA is used, for example: endangered over vulnerable. Where appropriate species recovery plan actions and/or outcomes.
- commercial fisheries: Victorian Fishing Authority core outcome of sustainable fishing and aquaculture (https://vfa.vic.gov.au/about).
- marine users: OPGGS Act 2006 (Cth) Section 280.

6.6 Evaluate and treat the potential impacts and risks

The following steps are undertaken using the environmental risk assessment matrix (Table 6-2) to evaluate the potential impacts and risks:

- identify the consequences of each potential environmental impact, corresponding to the maximum credible impact;

- for unplanned events, identify the likelihood (probability) of unplanned environmental impacts occurring;
- for unplanned events, assign a level of risk to each potential environmental impact using the risk matrix.
- identify control measures to manage potential impacts and risks to as low as reasonably practicable (ALARP) (Section 6.7) and an acceptable level (Section 6.8); and
- establish environmental performance standards for each of the identified control measures.

Table 6-2: Environmental risk assessment matrix

Environmental 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 occuring within the next year. Occurance requires exceptional circumstances. Exceptionally unlikely event in the long-term future. Only occur as a 100 year event.	>1% chance of occuring within the next year. May occur but not anticipated. Could occur years to decades.	>5% chance of occuring in the next year. May occur but not for a while. Could occur within a few years.	>10% chance of occuring within the next year. May occur shortly but a ditict probability iot won't. Could occur within months to years.	>50% chance of occuring within the next year. Balance of probability that it will occur. Could occur within weeks to months.	99% chance of occuring within the next year. Impact is occuring 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 or highly valued items or structures of great cultural significance. Negative international or prologed 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 1 day. NGO adverse attention.	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

6.7 Demonstration of ALARP

Beach's approach to demonstration of ALARP includes:

- systematically identify and assess all potential environmental impacts and risks associated with the activity;
- where relevant, apply industry 'good practice' controls to manage impacts and risks;
- assess the effectiveness of the controls in place and determine whether the controls are adequate according to the 'hierarchy of control' principle;
- for higher order impacts and risks undertake a layer of protection analysis and implement further controls if both feasible and reasonably practicable to do so.

NOPSEMA's EP decision making guideline (NOPSEMA, 2019) states that in order to demonstrate ALARP, a titleholder must be able to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure.

For this EP, the guidance provided in NOPSEMA's EP decision making guideline (NOPSEMA, 2019) has been applied, whereby the level of ALARP assessment is dependent upon the:

- residual impact and risk level (high versus low); and
- the degree of uncertainty associated with the assessed impact or risk.

The following section details how the guidance provided in NOPSEMA's EP decision making guideline (NOPSEMA, 2019).

6.7.1 Residual impact and risk levels

Lower-order environmental impacts and risks

NOPSEMA defines lower-order environmental impacts and risks as those where the environment or receptor is not formally managed, less vulnerable, widely distributed, not protected and/or threatened and there is confidence in the effectiveness of adopted control measures.

Impacts and risks are considered to be lower-order and ALARP when, using the environmental risk assessment matrix, the impact consequence is rated as 'minor' or 'moderate' or risks are rated as 'low', 'medium' or 'high.' In these cases, applying 'good industry practice' (as defined in Section 6.7.2.1) is sufficient to manage the impact or risk to ALARP.

Higher-order environmental impacts and risks

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

Impacts and risks are considered to be higher-order when, using the environmental risk assessment matrix (Table 6-2), the impact consequence is rated as 'serious', 'major', 'critical' or 'catastrophic', or when the risk is rated as 'severe' or 'extreme'. In these cases, further controls must be considered as per Section 6.7.2.

An iterative risk evaluation process is employed until such time as any further reduction in the residual risk ranking is not reasonably practicable to implement. At this point, the impact or risk is reduced to ALARP. The determination of ALARP for the consequence of planned operations and the risks of unplanned events is outlined in Table 6-3.

Table 6-3: ALARP determination for consequence (planned operations) and risk (unplanned events)

Consequence ranking	Minor	Moderate	Serious	Major	Critical	Catastrophic
Planned operation	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual impact category	Lower order impacts		Higher order impacts			
Risk ranking	Low	Medium	High	Severe	Extreme	
Unplanned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual risk category	Lower order risks			Higher order risks		

6.7.2 Uncertainty of impacts and risks

In addition to the evaluation of residual impacts and risks as described above, the relative level of uncertainty associated with the impact or risk is also used to inform whether the application of industry good practice is sufficient to manage impacts and risks to ALARP, or if the evaluation of further controls is required.

In alignment with NOPSEMA's ALARP Guidance Note (NOPSEMA, 2015), Beach have adapted the approach developed by Oil and Gas UK (OGUK) (OGUK, 2014) for use in an environmental context to determine the assessment technique required to demonstrate that potential impacts and risks are ALARP (Figure 6-2). Specifically, the framework considers impact severity and several guiding factors:

- activity type;
- risk and uncertainty; and
- stakeholder influence.

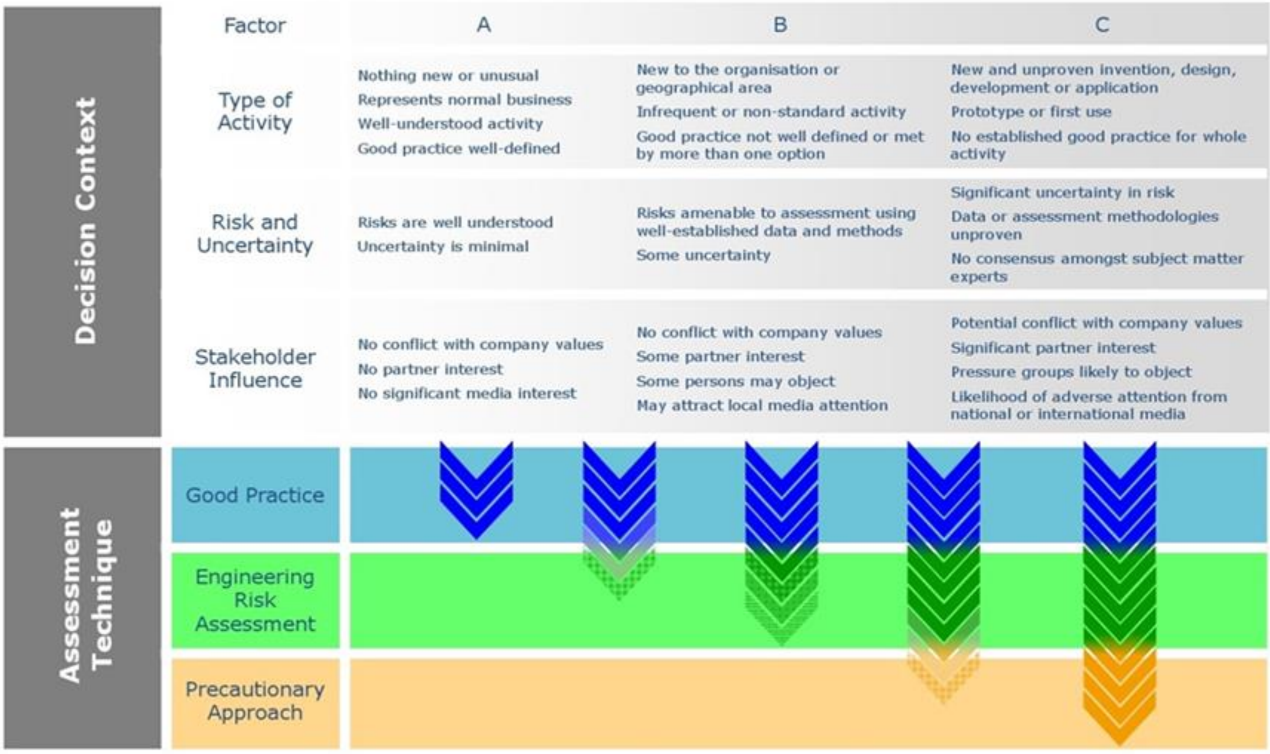


Figure 6-2: OGUK (2014) decision support framework

A **Type A** decision is made if the risk is relatively well understood, the potential impacts are low, activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. However, if good practice is not sufficiently well-defined, additional assessment may be required.

A **Type B** decision is made if there is greater uncertainty or complexity around the activity and/or risk, the potential impact is moderate, and there are no conflict with company values, although there may be some partner interest, some persons may object, and it may attract local media attention. In this instance, established good practice is not considered sufficient and further assessment is required to support the decision and ensure the risk is ALARP.

A **Type C** decision typically involves sufficient complexity, high potential impact, uncertainty, or stakeholder influence to require a precautionary approach. In this case, relevant good practice still must be met, additional assessment is required, and the precautionary approach applied for those controls that only have a marginal cost benefit.

In accordance with the regulatory requirement to demonstrate that environmental impacts and risks are ALARP, Beach has considered the above decision context in determining the level of assessment required.

The levels of assessment techniques considered include:

- good practice;
- engineering risk assessment; and
- precautionary approach.

6.7.2.1 Good practice

OGUK (2014) defines 'good practice' as the recognised risk management practices and measures that are used by competent organisations to manage well-understood impacts and risks arising from their activities.

'Good practice' can also be used as the generic term for those measures that are recognised as satisfying the law. For this EP, sources of good practice include:

- requirements from Australian legislation and regulations;
- relevant Australian policies;
- relevant Australian Government guidance;
- relevant industry standards and/or guidance material; and
- relevant international conventions.

If the ALARP technique is determined to be 'good practice', further assessment ('engineering risk assessment') is not required to identify additional controls. However, additional controls that provide a suitable environmental benefit for an insignificant cost are also identified at this point.

6.7.2.2 Engineering risk assessment

All potential impacts and risks that require further assessment are subject to an 'engineering risk assessment'. Based on the various approaches recommended in OGUK (2014), Beach believes the methodology most suited to this activity is a comparative assessment of risks, costs, and environmental benefit. A cost–benefit analysis should show the balance between the risk benefit (or environmental benefit) and the cost of implementing the identified measure, with differentiation required such that the benefit of the control can be seen and the reason for the benefit understood.

6.7.2.3 Precautionary approach

OGUK (2014) states that if the assessment, considering all available engineering and scientific evidence, is insufficient, inconclusive, or uncertain, then a precautionary approach to impact and risk management is needed. A precautionary approach will mean that uncertain analysis is replaced by conservative assumptions that will result in control measures being more likely to be implemented.

That is, environmental considerations are expected to take precedence over economic considerations, meaning that a control measure that may reduce environmental impact is more likely to be implemented. In this decision context, the decision could have significant economic consequences to an organisation.

6.8 Demonstration of acceptability

Regulation 13(5)(c) of the OPGGS(E)R requires demonstration that environmental impacts and risks are of an acceptable level.

Beach considers a range of factors when evaluating the acceptability of environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in Section 6.8.1 which is based on Beach's interpretation of the NOPSEMA EP content requirements (NOPSEMA, 2019).

6.8.1 Acceptability Criteria

Beach has defined a set of criteria to determine acceptability of an impact or risk, following risk mitigation. Where an impact or risk is not considered acceptable, further control measures are required to lower the risk, or alternative options will be considered. The Beach acceptability criteria considers:

- principles of Ecological Sustainable Development (ESD)
- internal Context
- external Context
- other requirements.

These criteria are described in the following sections and are consistent with NOPSEMA EP content requirements (NOPSEMA, 2019).

6.8.1.1 Principles of Ecologically Sustainable Development

Section 3A of the EPBC Act defines ecologically sustainable development (ESD), which is based on Australia's National Strategy for Ecological Sustainable Development (1992) that defines ESD as:

'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.'

Relevant ESD principles and how they are applied by Beach:

- decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations. This principle is inherently met through the EP development process, as such this principal is not considered separately for each acceptability evaluation.
- if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. If there is, the project shall assess whether there is significant uncertainty in the evaluation, and if so, whether the precautionary approach should be applied.
- the principle of inter-generational equity — that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. The EP risk assessment methodology ensures that potential impacts and risks are ALARP, where the potential impacts and risks are determined to be serious or irreversible the precautionary principle is implemented to ensure the environment is maintained for the benefit of future generations. Consequently, this principal is not considered separately for each acceptability evaluation.
- the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making. Beach considers if there is the potential to affect biological diversity and ecological integrity through the risk assessment process.

To meet this acceptance criteria, the activity must be carried out in a manner consistent with the relevant ESD principles above.

6.8.1.2 Internal Context

The Health Safety and Environment Management System (HSEMS) includes Standards and Procedures relevant to the way Beach operates.

At the core of the HSEMS are 20 performance standards which detail specific performance requirements for the implementation of the HSE Environmental Policy and management of potential HSE impacts and risks

Where relevant, Standards and Procedures in the management system which are relevant to either the activity, impact, control or receptor will be described within the internal context and contribute towards the assessment of acceptability.

To meet this acceptance criteria, the impact or risk must be compliant with the objectives of the company HSE Environment Policy. Where specific internal procedures, guidelines, expectations are in place for management of the impact or risk in question, acceptability is demonstrated.

6.8.1.3 External Context

External context considers stakeholder expectations, obtained from stakeholder consultation.

Beach has undertaken stakeholder consultation, which is described in detail in Section 9. Where objections or claims have been raised, these are considered in the assessment of acceptability of related impacts and risks.

To meet this acceptance criteria, the merits of claims or objections raised by a relevant stakeholder must have been adequately assessed and additional controls adopted where appropriate.

6.8.1.4 Other Requirements

Aside from internal and external context, other requirements must be considered in the assessment of acceptability. These include:

- environmental legislation (described in Section 3)
- policies and guidelines (described in Section 3.3)
- international agreements (described in Section 3)
- EPBC Management Plans (described in Section3.1)
- Australian Marine Park designations (described in Section 5.2).

This acceptance criteria is met when: compliance with specific laws or standards is demonstrated; management of the impact or risk is consistent with relevant industry practices; and the proposed impact or risk controls, environmental performance objectives and standards are consistent with the nature of the receiving environment based upon formal management plans.

6.9 Monitoring and review

Monitoring and review activities are incorporated into the impact and risk management process to ensure that controls are effective and efficient in both design and operation. This is achieved through the environmental performance outcomes, environmental performance standards and measurement criteria that are described for each environmental impact or risk. Monitoring and review are described in detail in the Implementation Strategy (Section 8).

7 Environmental Impact and Risk Assessment

7.1 Overview

In alignment with Regulation 13 (5) of the OPGGS(E)R, this section of the EP details the potential environmental impacts and risks associated with the activity and provides an evaluation of all the impacts and risks appropriate to the nature and scale of each impact or risk. This evaluation includes impacts and risks arising directly or indirectly from the activity and includes potential oil pollution emergencies and the implementation of oil spill response strategies and oil spill monitoring.

In addition, this section details the control measures (systems, procedures, personnel or equipment) that will be used to reduce potential impacts and risks to ALARP and acceptable levels. Environmental performance outcomes (EPOs), environmental performance standards (EPSs) and measurement criteria associated with each of the identified control measures are provided in Section 7.20.

For oil spill response options aspects associated with the use of vessels are as per vessel operations in Table 7-1. Other related impacts and risks are described in Sections 7.19.

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Table 7-1: Activity – Aspect Relationship

Aspect

	Light emissions	Atmospheric emissions	Underwater noise emissions	Physical presence	Benthic disturbance	Planned Marine discharges				Establishment of IMS	Collision with marine fauna	Entanglement with marine fauna	Unplanned marine discharges			
ACTIVITIES						Cooling water, brine, sewage and grey water, deck drainage, bilge, putrescible food waste	Hydraulic control and suspension fluids	Drill fluids and cuttings	Cement				Waste	Loss of containment (LOC) - chemicals	Loss of containment (LOC) - hydrocarbons	Loss of well control (LOWC)
Routine Support																
MODU operations	✓	✓	✓	✓	✓	✓				✓			✓	✓	✓	
Vessel operations	✓	✓	✓	✓		✓				✓	✓		✓	✓	✓	
Helicopter operations				✓							✓					
ROV operations					✓		✓									
Anchors insitu				✓	✓							✓				
Drilling																
Drilling			✓		✓											✓
Blow-out preventer installation and function testing							✓									
Drill fluids and cuttings handling and disposal								✓								
Cementing operations									✓							
Well suspension							✓		✓							✓
Plug and abandonment									✓							

7.2 Light emissions

7.2.1 Hazards

As the activity will be undertaken 24 hours a day, lighting is required at night for navigation and to ensure safe operations when working on the MODU and vessels. Light emissions from MODU and vessel operations will result in a change in ambient light.

7.2.2 Known and potential environmental impacts

Changes in ambient light can lead to changes in fauna behaviour, through attraction of light-sensitive species. Light sensitive species have been identified by reviewing the National Light Pollution Guidelines for Wildlife (the guidelines) (Commonwealth of Australia, 2020). The guidelines identify marine turtles, seabirds and migratory shorebirds as potentially being impacted by artificial light to a level significant enough to require assessment. Other species such as fish are discussed in the guidelines but have not been identified in the guidelines as requiring assessment and thus this is taken as impacts to them are not likely to be of a level that requires further assessment.

7.2.3 Consequence evaluation

For the light impact assessment, the process outlined in the guidelines is used. The aim of the guidelines is that artificial light will be managed so wildlife is:

1. Not disrupted within, nor displaced from, important habitat

2. Able to undertake critical behaviours such as foraging, reproduction and dispersal.

The guidelines recommend undertaking a light impact assessment where important habitat for list species sensitive to light are located within 20 km of the light source. The guidelines detail that important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal. For this assessment a distance of 20 km from the well location was used to identify any areas where turtles, shorebirds and seabirds may be foraging, breeding, roosting or migrating. The well location was used as the MODU will generate greater light emissions than the one support vessels that will be within 2 km of the MODU. Thus, for this assessment a distance of 20 km from the well location is used and is called the light EMBA.

Table 7-2 details the turtles, shorebirds and seabirds that may be foraging, breeding, roosting or migrating within the light EMBA. These were identified from the light EMBA PMST Report (Appendix A.3) and BIAs from the National Conservation Atlas.

Artificial light can disrupt turtle nesting and hatching behaviours. Artificial light is listed as a key threat in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). The listed turtle species may occur within the light EMBA, however, no biologically important behaviours, BIAs or habitat critical to survival for marine turtles were identified. Therefore, impacts to turtles from light emissions is not predicted.

Table 7-2: Light sensitive receptors within the light EMBA

Receptor	PMST Report Type of presence	BIA (Area)	% light EMBA overlap with BIA
Albatross			
Antipodean albatross	Foraging likely	Foraging ($1,063,053\ km^2$) Figure 7-4	0.12%
Black-browed albatross	Foraging likely	Foraging ($1,156,937\ km^2$) Figure 7-5	0.11%
Buller's albatross	Foraging likely	Foraging ($685,810\ km^2$) Figure 7-6	0.18%
Campbell albatross	Foraging likely	Foraging ($1,156,937\ km^2$) Figure 7-7	0.11%
Indian yellow-nosed albatross	-	Foraging ($1,156,937\ km^2$) Figure 7-8	0.11%
Northern Buller's albatross	Foraging likely	NA	NA
Northern royal albatross	Foraging likely	NA	NA
Pacific albatross	Foraging likely	NA	NA
Salvin's albatross	Foraging likely	NA	NA
Shy albatross	Foraging likely	Foraging ($1,195,256\ km^2$) Figure 7-9	0.11%
Southern royal albatross	Foraging likely	NA	NA
Wandering albatross	Foraging likely	Foraging ($1,156,937\ km^2$) Figure 7-10	0.11%
White-capped albatross	Foraging likely	NA	NA
Other			
Australian fairy tern	Foraging likely	NA	NA
Common diving-petrel	-	Foraging ($437,403\ km^2$)	0.29%
Orange-bellied parrot	Migrating likely	NA	NA
Short-tailed shearwater	Foraging likely	Foraging ($235,363km^2$)	0.06%
Wedge-tailed shearwater	-	Breeding/foraging area ($34,731\ km^2$)	3.62%

There are no islands or coasts where shorebirds and seabirds may be present within the light EMBA (Figure 7-3). The following species where identified as having BIAs within the broader spill EMBA but not within the light EMBA and therefore impacts to them are not predicted:

- Australasian gannet: the light EMBA is 65 km (85 km from the operational area less 20 km) from the closest Australasian gannet BIA (Figure 7-1).
- black-faced cormorant: the light EMBA is 98 km (108 km from the operational area less 20 km) from the closest black-faced cormorant BIA (Figure 7-2).
- little penguin: the light EMBA is 90 km (110 km from the operational area less 20 km) from the closest little penguin BIA (Figure 7-3).
- white-faced storm-petrel: the light EMBA is 43 km (63 km from the operational area less 20 km) from the closest white-faced storm-petrel BIA Figure 7-1.

The light EMBA PMST Report (Appendix A.3) identified likely foraging behaviour for a number of albatrosses in the light EMBA (Table 7-2). Some of these species have foraging BIAS that the light EMBA overlaps (Table 7-2). These BIAs are shown in Figure 7-4 to Figure 7-10. Light emissions are not identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). Albatrosses forage most actively during daylight and are less active at night because their ability to see and capture prey from the air is reduced (Phalan et al. 2007). Thus, impacts within the small area of overlap with albatross foraging BIAs (maximum 018%) are not predicted based on these species forage most actively during daylight.

The light EMBA PMST Report (Appendix A.3) identified likely foraging behaviour for the fairy tern in the light EMBA (Table 7-2). No BIAs or habitat critical to the survival of the Australian fairy tern are within the light EMBA. Light emissions are not identified as a threat in the approved conservation advice for the fairy tern (DSEWPC, 2011c) or the draft recovery plan (DotEE, 2019b). The draft recovery plan (DotEE, 2019b) details that Australian fairy terns feed almost entirely on fish in near-shore waters adjacent to nesting colonies and around island archipelagos. Higgins & Davies (1996) cited in DotEE (2020) detail that the birds roost at night. Thus, based on the information that the birds roost at night they are unlikely to be impacted by light in the light EMBA.

The common diving-petrel was not identified in the light EMBA PMST Report (Appendix A.3). This species is listed as marine and does not have a recovery plan or conservation advice. The light EMBA overlaps 0.29% of a foraging BIA (Figure 7-11). Brooke (2004) cited on Animal Diversity Web (2020) details that common diving petrels spend the night in burrows during the breeding season and seem to forage mainly during the day, although they also forage at night on vertically migrating plankton. They are thought to be fairly sedentary, remaining more or less in the area of their breeding colony year-round, although they may venture into the open ocean to forage outside of the breeding season and some studies suggest seasonal movements (Brooke, 2004 cited on Animal Diversity Web, 2020). Based on this information, common diving-petrels may forage at night within the light EMBA.

The light EMBA PMST Report (Appendix A.3) identified migration route likely for the orange-bellied parrot. No BIA or habitat critical to the survival of the species where identified. The orange-bellied parrot is a ground feeding parrot which breeds in south-west Tasmania between November and March and then overwinters on the coast of south-east mainland Australia between April and October (DELWP, 2016a). The orange-bellied parrot is classed as critically endangered and there are about 50 remaining in the wild (DELWP, 2016a). The orange-bellied parrot recovery plan identifies illuminated structures and illuminated boats as a potential barrier to migration and movement (DELWP, 2016a). Drilling may occur during the period when orange-bellied parrots migrate between Tasmania and Victoria between late February to early April (Australian Museum, 2020). Figure 7-14 shows known and probable migration route for the orange-bellied parrot (DELWP, 2016a). A section of the light EMBA overlaps the probable migration route by 0.35% (190 km^2 area of overlap of probable migration route 53,734 km^2). However, the area of overlap could be more or less as the actual boundaries of the migration route are not known.

The short-tailed shearwater was identified in the light EMBA PMST Report as foraging likely within the light EMBA. The light EMBA overlaps 0.06% of the foraging BIA (Figure 7-12). This species is listed as marine and migratory and does not have a recovery plan or conservation advice. No BIAs or habitat critical for the survival of the species occur within the light EMBA. Impacts to this species from light emissions are not predicted as the short-tailed shearwater returns to the colonies at dark after feeding at sea during the day (AAD, 2020).

The wedge-tailed shearwater was not identified in the light EMBA PMST Report (Appendix A.3). The light EMBA overlaps 3.62% of a breeding, foraging BIA which is a buffer around Muttonbird Island, Victoria (NCVA, 2020) (Figure 7-13). This species is listed as marine and migratory and does not have a recovery plan or conservation advice. Light has not been identified as a threat to this species (DotEE, 2020d). A review of the DotEE Species Profile and Threats Database (SPRAT), Atlas of Living Australia and South-east Marine Region Profile did not provide any information on the Victorian Muttonbird Island wedge-tailed shearwater colony. The DotEE SPRAT profile does not show any locations for the wedge-tailed shearwater in Victoria and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of Wedge-tail shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border. However, impacts to this species from light emissions are not predicted as Warham, (1996) cited in Beaver (2018) details that the wedge-tailed shearwater forms large aggregations referred to as "rafts" just offshore from their breeding colony just on dusk and enter and leave the colony at night to avoid predators.

The extent of the area of impact is predicted to be 20 km from the MODU for a duration of up to 55 days while the MODU and support vessel are on location. The severity (with no controls) is assessed as moderate based on:

- of the seabirds that may potentially forage within the light EMBA only the common diving-petrel was identified as foraging at night.
- the light EMBA overlaps 0.29% of the common diving-petrel BIA.
- the orange-bellied parrot, which is classed as critically endangered, may migrate over the light EMBA while drilling is occurring. Illuminated structures and illuminated boats have been identified as a potential barrier to migration and movement for this species (DELWP, 2016a).
- the light EMBA does not overlap any islands or coasts where shorebirds and seabirds may roost or breed.

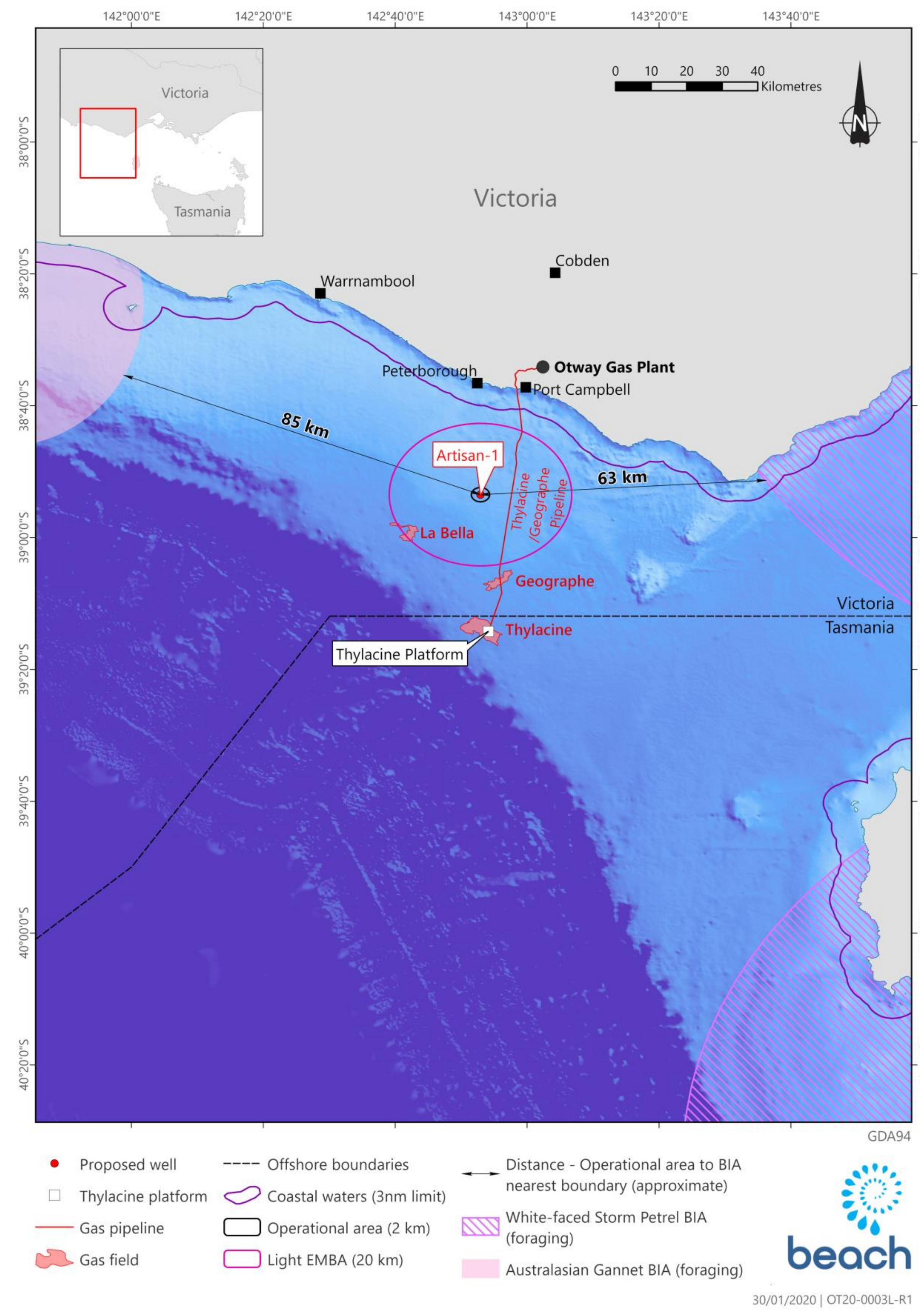

Figure 7-1: Light EMBA and Australasian gannet and white-faced storm petrel BIAs

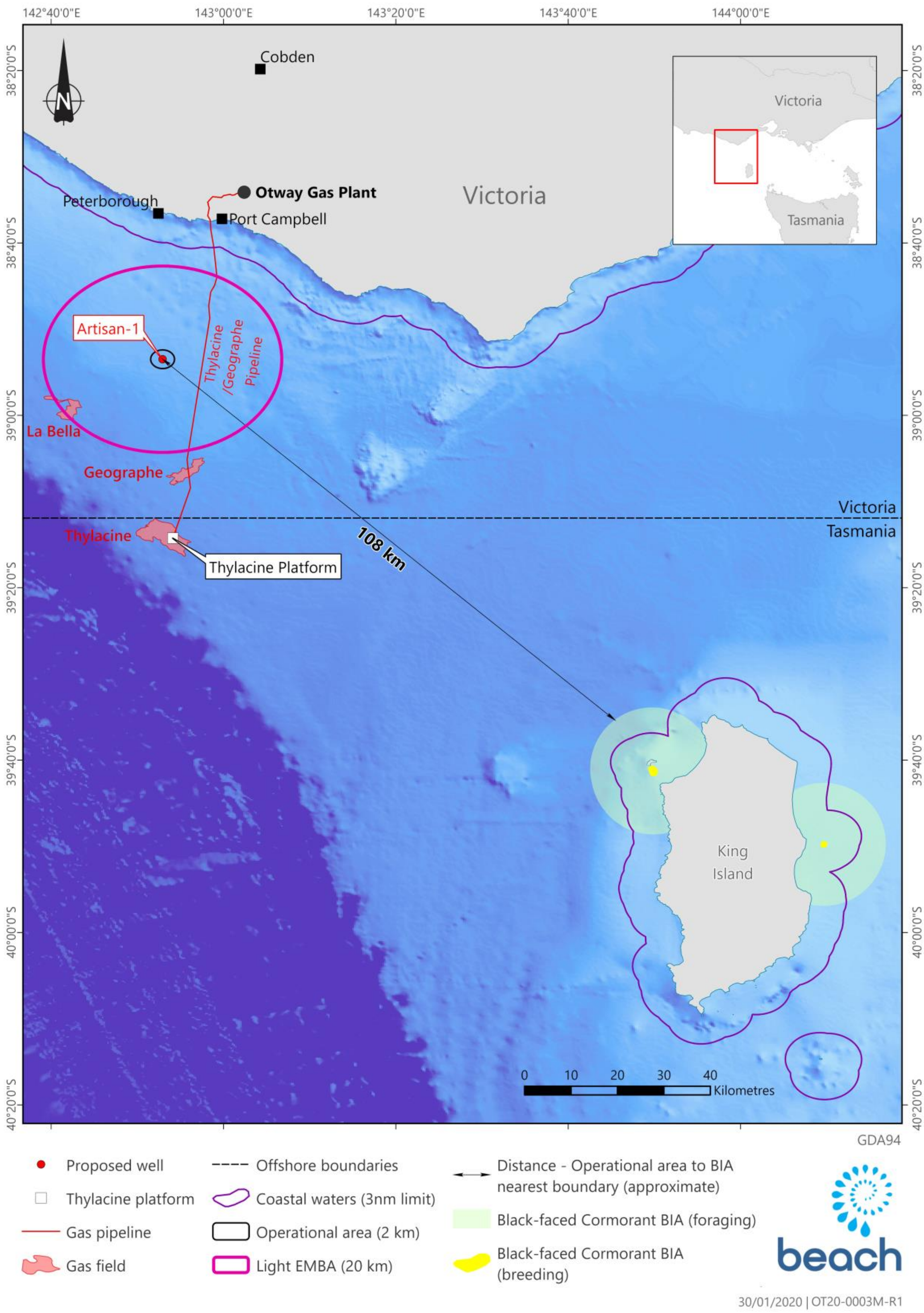

Figure 7-2: Light EMBA and black-faced cormorant BIAs

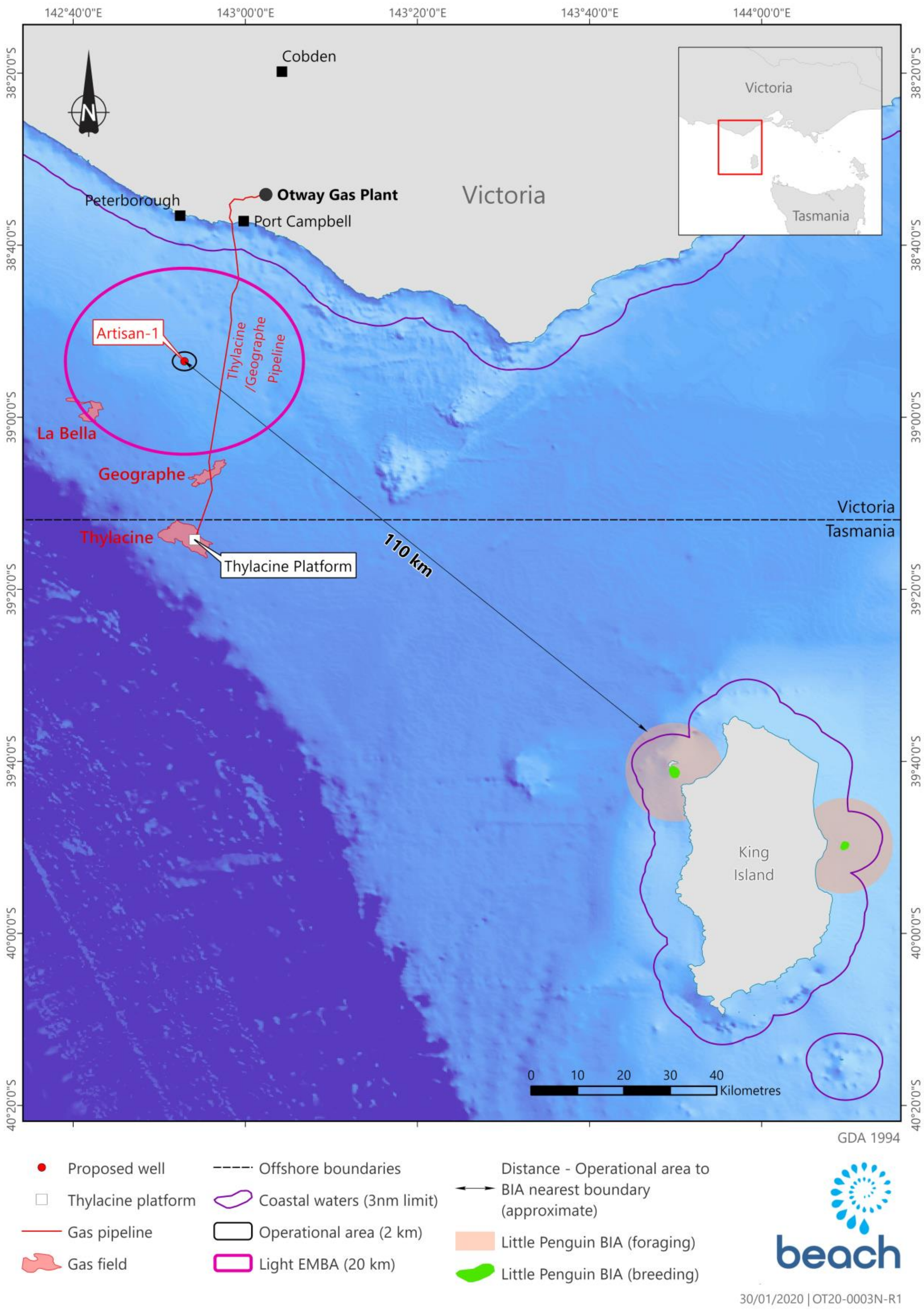

Figure 7-3: Light EMBA and little penguin BIAs

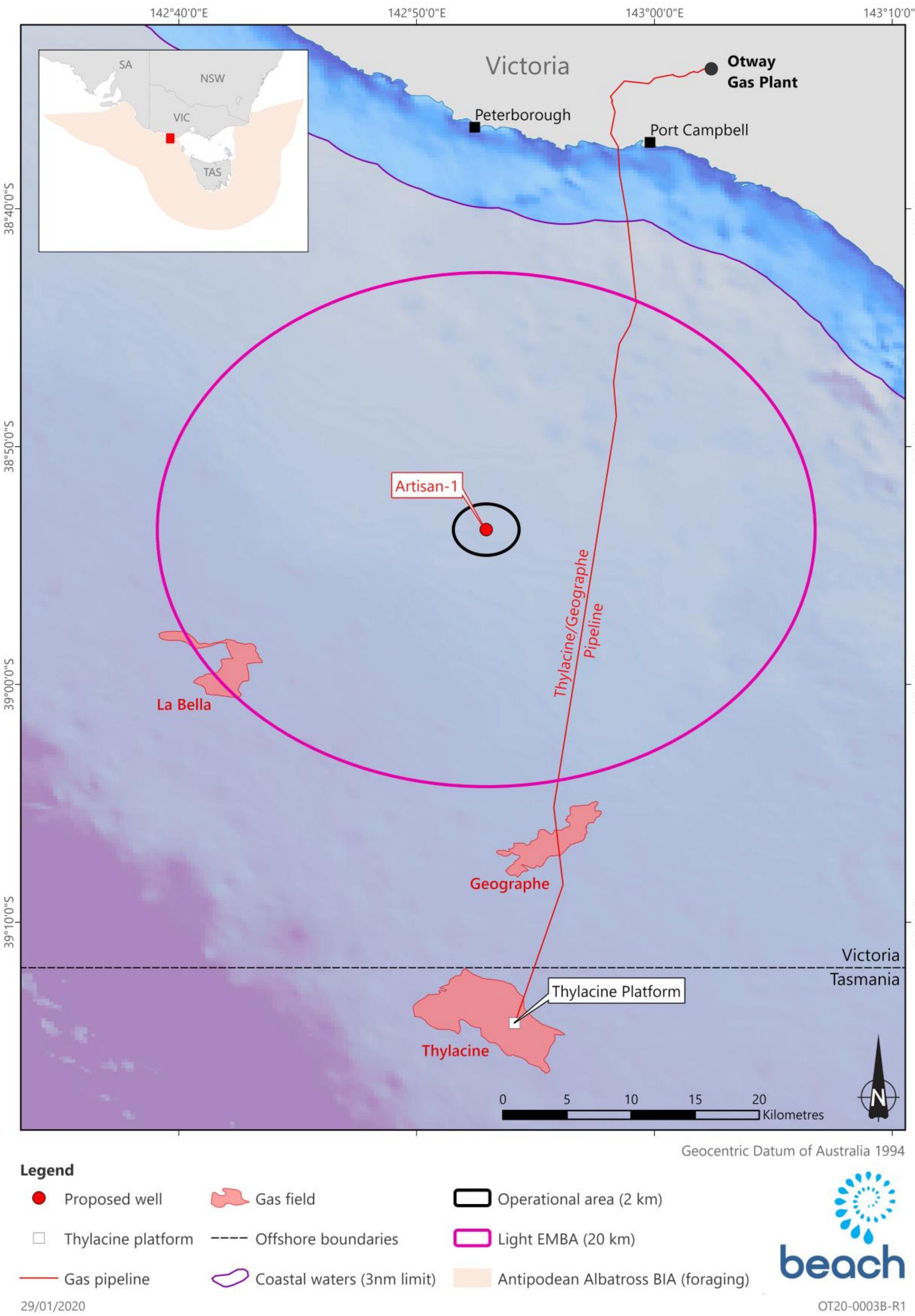

Figure 7-4: Light EMBA and antipodean albatross foraging BIA

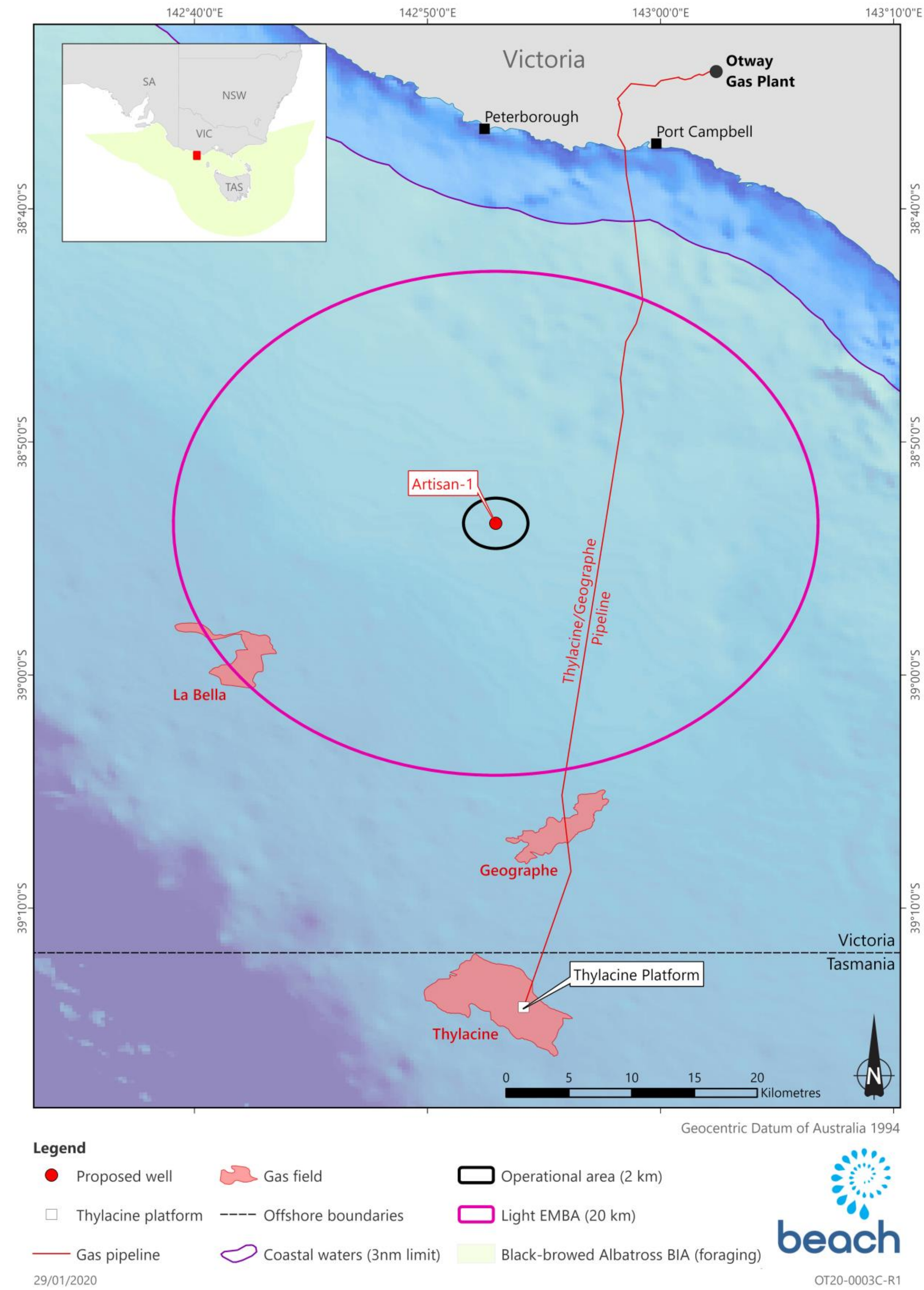

Figure 7-5: Light EMBA and black-browed albatross foraging BIA

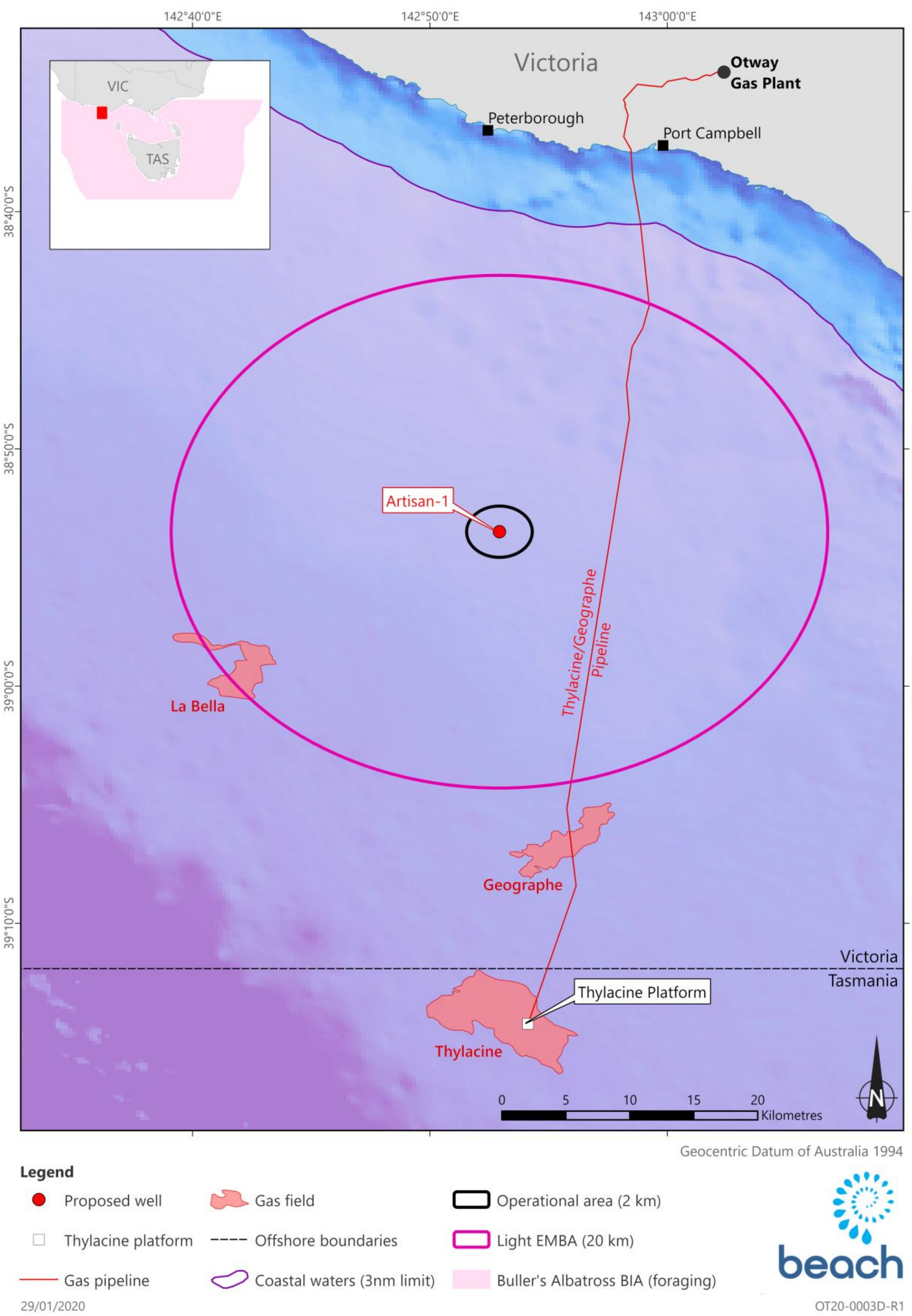

Figure 7-6: Light EMBA and Buller's albatross foraging BIA

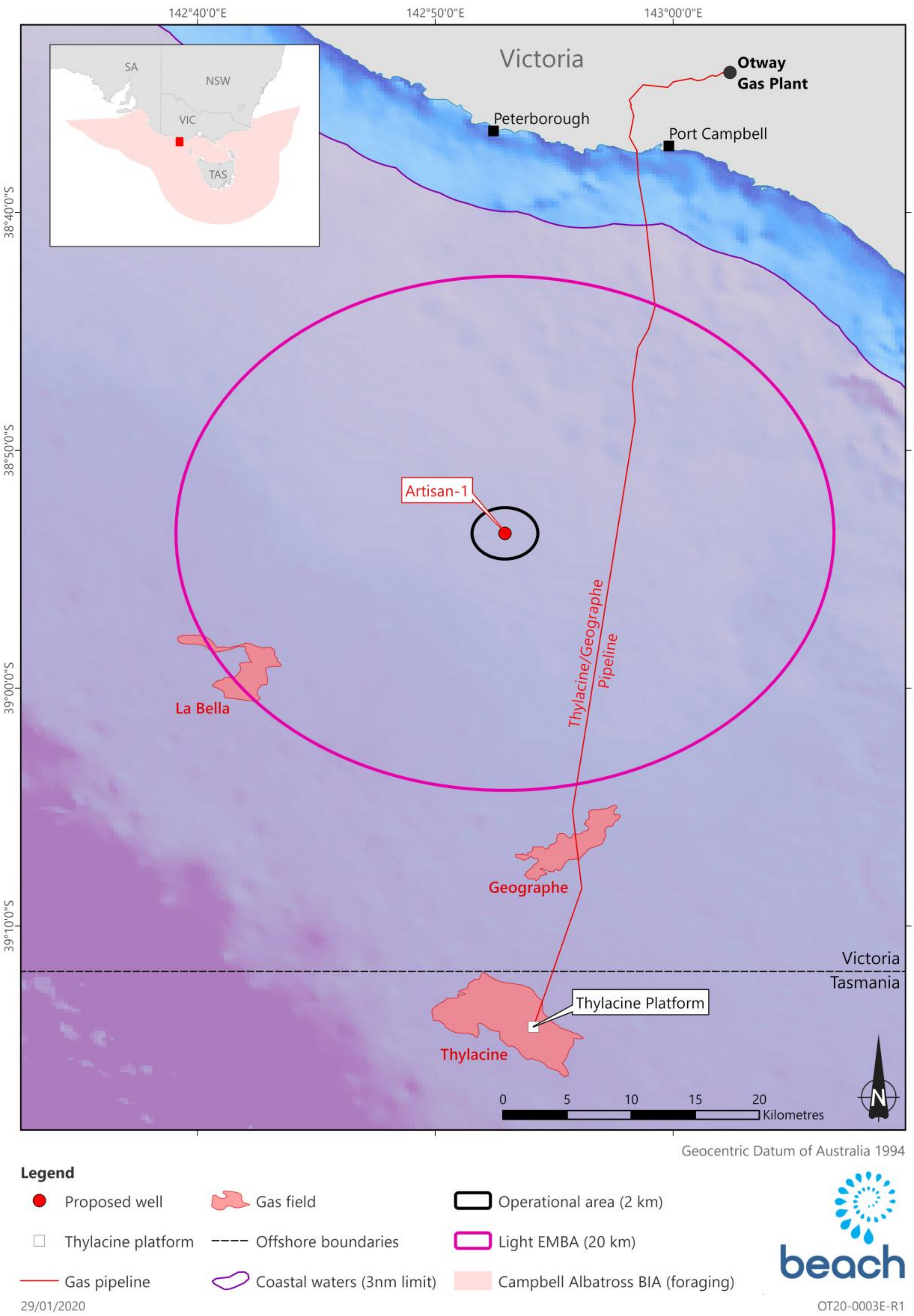

Figure 7-7: Light EMBA and Campbell albatross foraging BIA

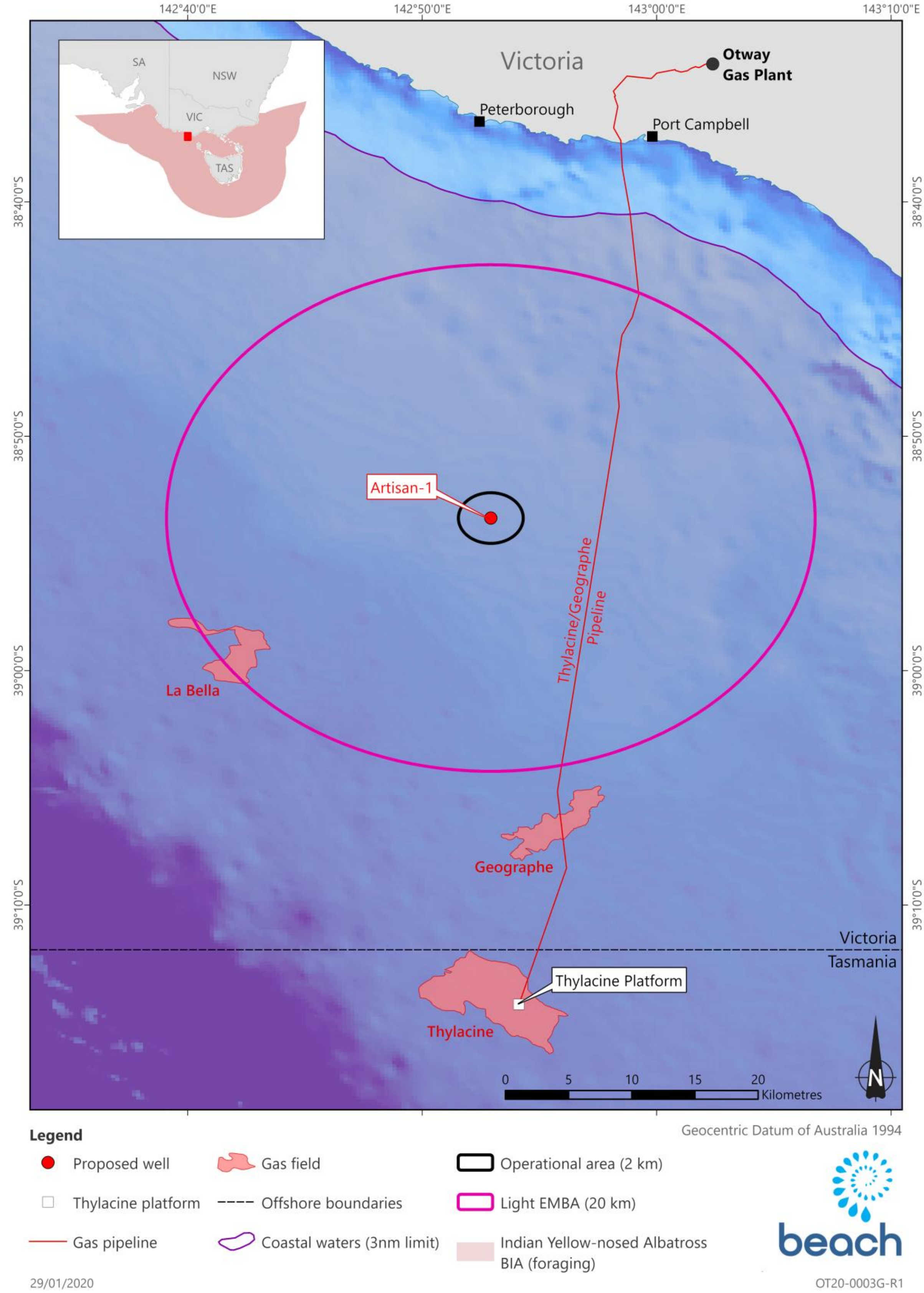

Figure 7-8: Light EMBA and Indian yellow-nosed albatross foraging BIA

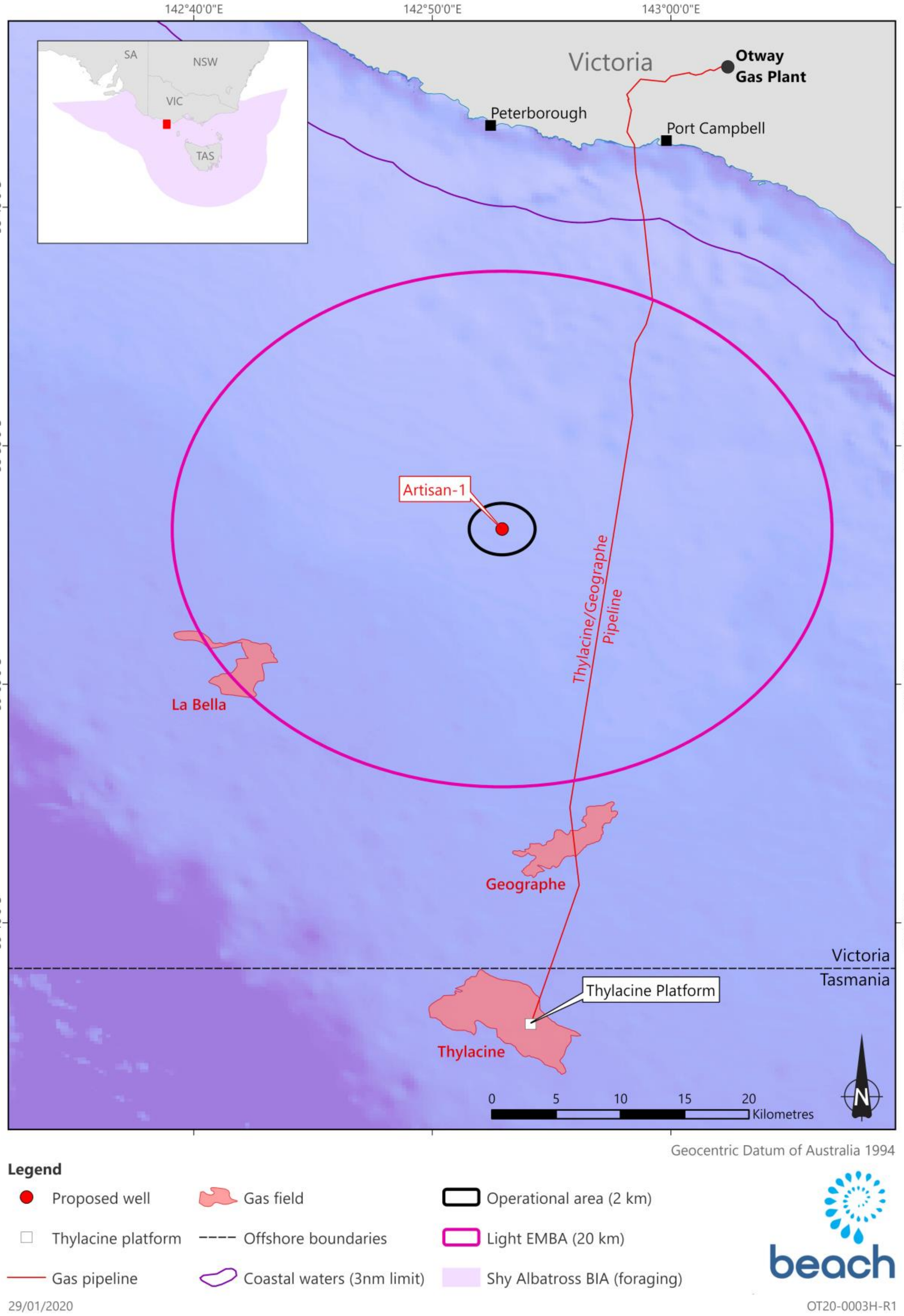

Figure 7-9: Light EMBA and shy albatross foraging BIA

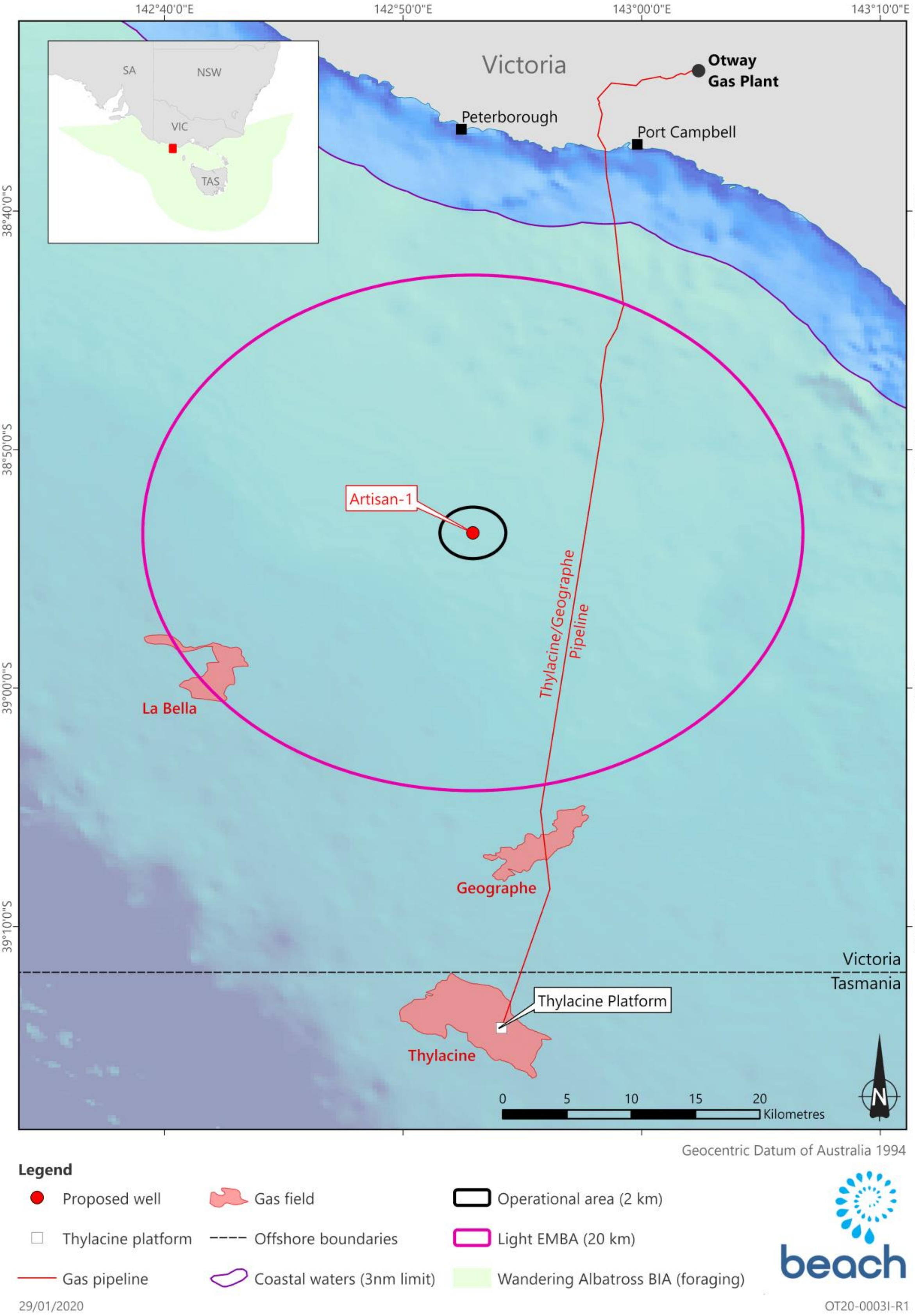

Figure 7-10: Light EMBA and wandering albatross foraging BIA

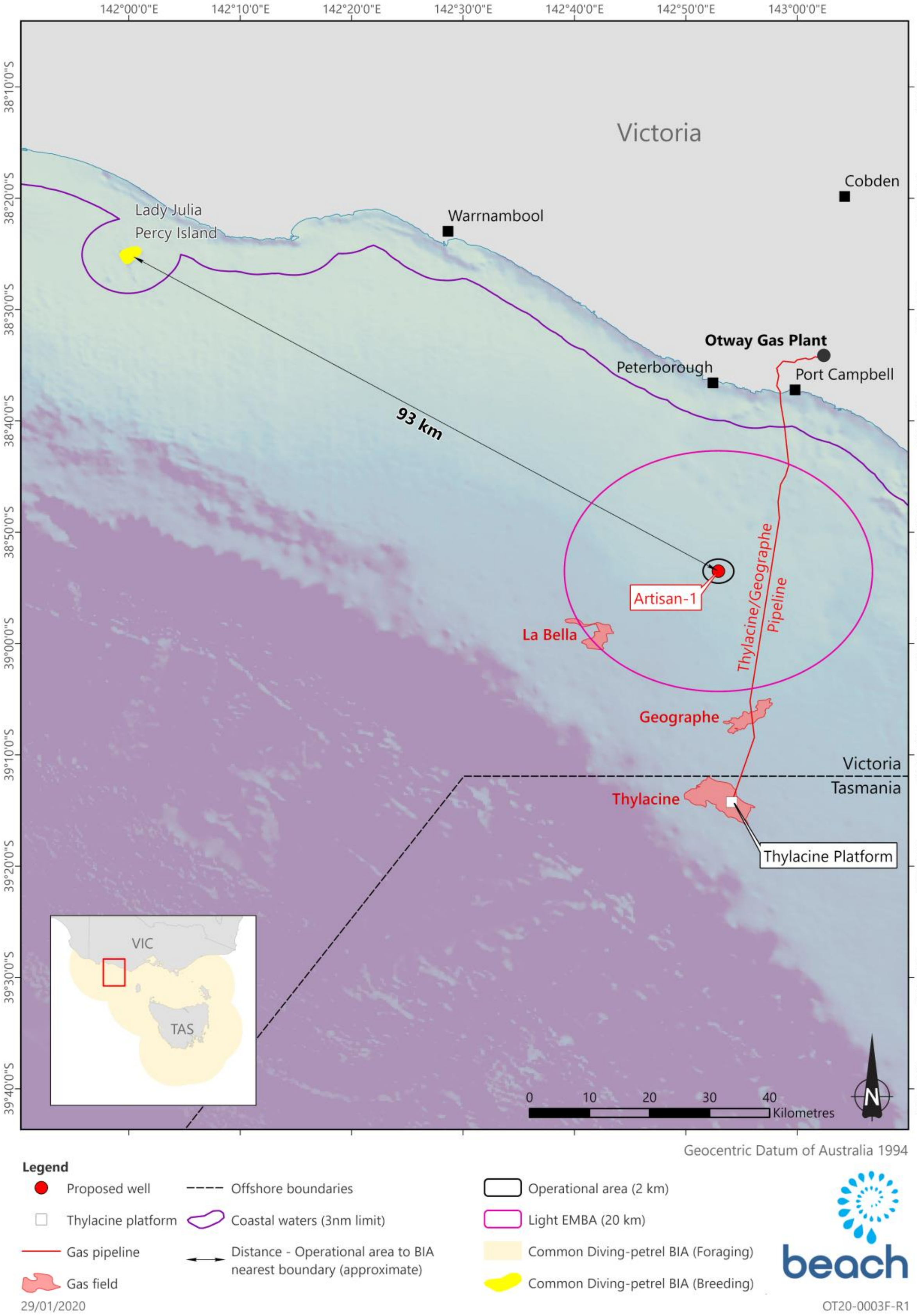

Figure 7-11: Light EMBA and common diving-petrel foraging BIA

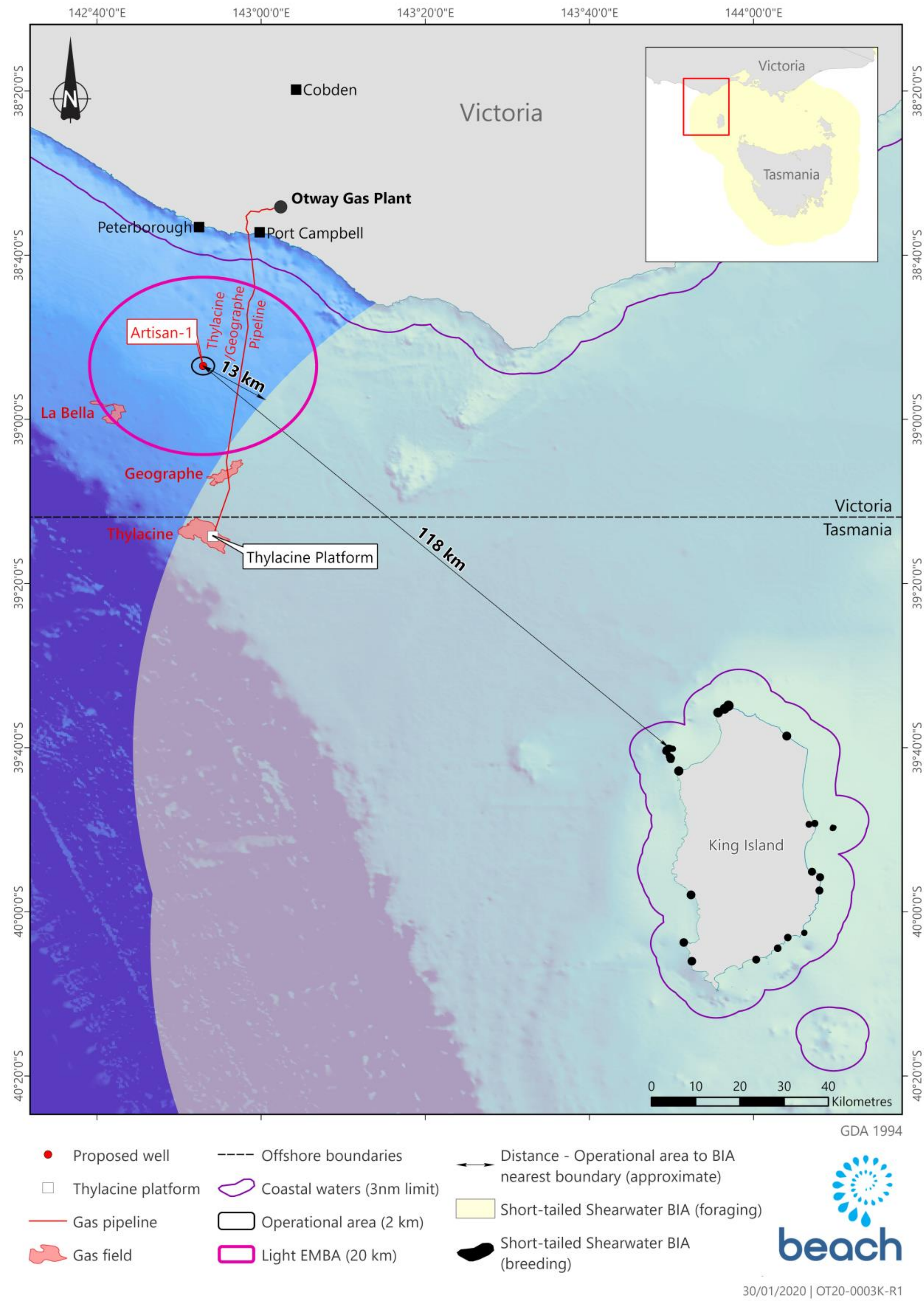

Figure 7-12: Light EMBA and short-tailed shearwater foraging BIA

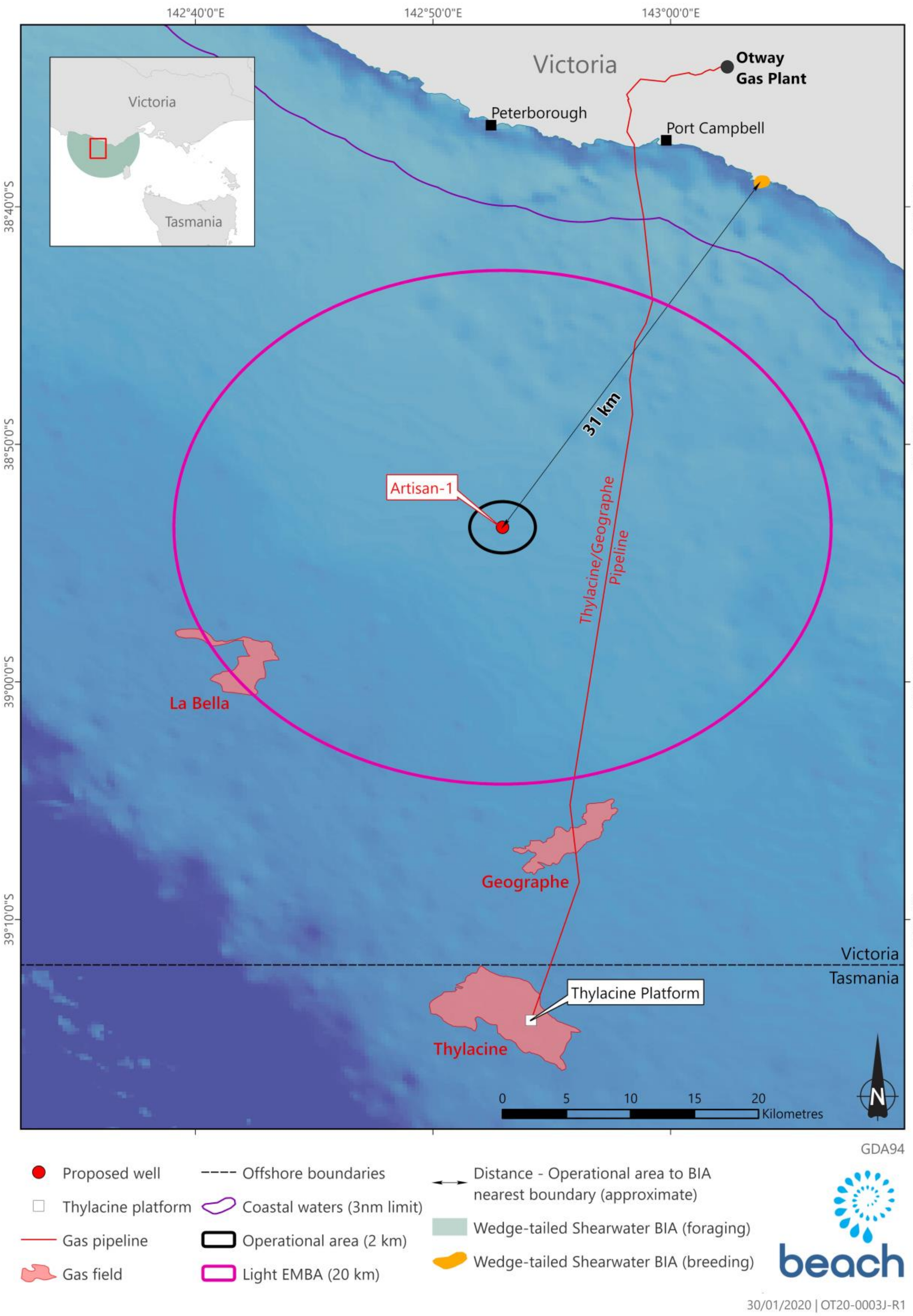

Figure 7-13: Light EMBA and wedge-tailed shearwater foraging BIA

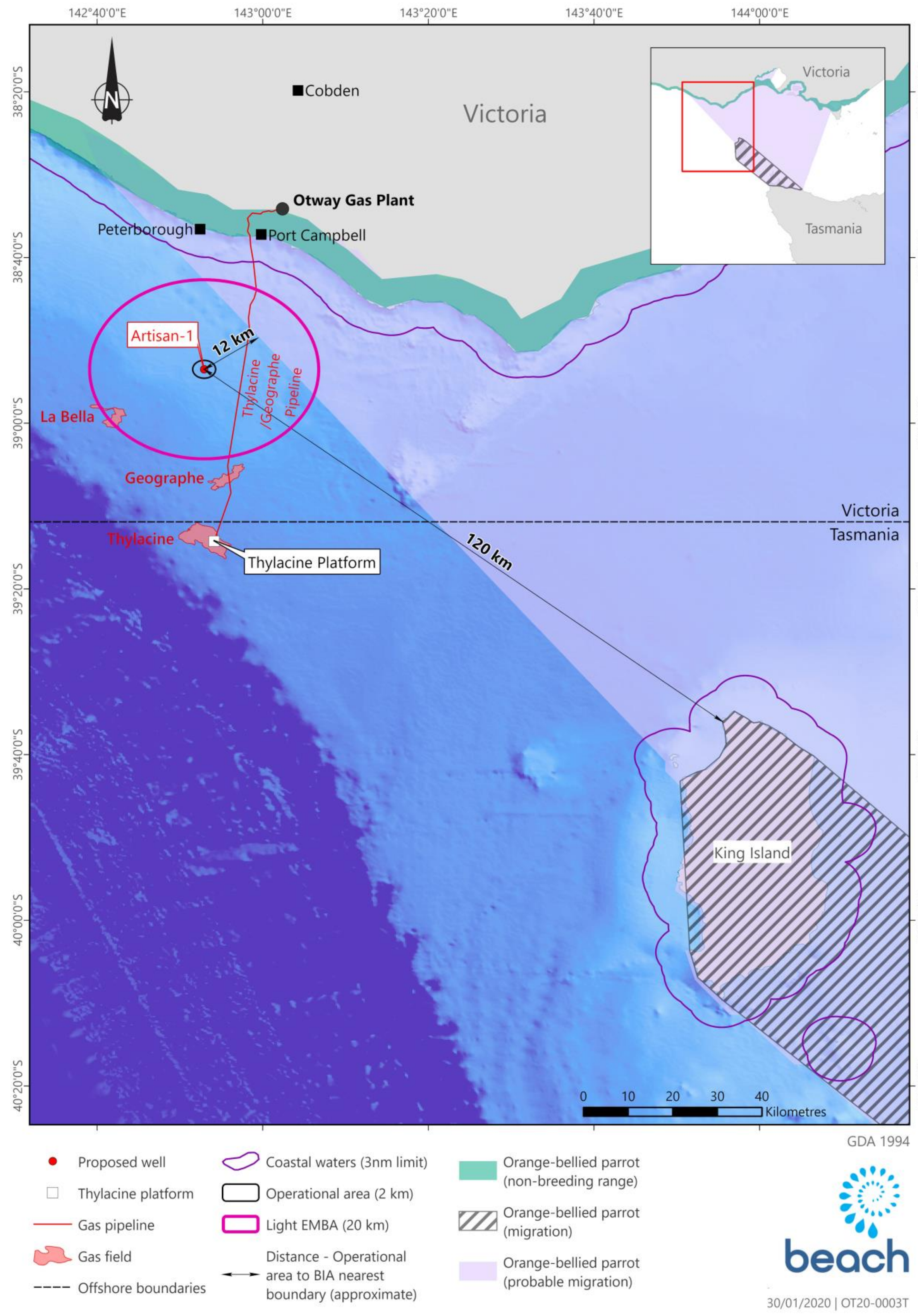

Figure 7-14: Light EMBA and orange-bellied parrot migration areas

7.2.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Light emissions	
ALARP decision context and justification	**ALARP Decision Context: Type B** Impacts from light emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
CM#1: National Light Pollution Guidelines for Wildlife	The guidelines provide management options for mitigating the effect of light to seabirds. A review of the management options relevant to the drilling activity is provided in the additional controls section with the following to be adopted: A Seabird Lighting Management Plan will be developed and implemented as per the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). The Seabird Lighting Management Plan will detail: • activity lighting. • seabird population and behaviour within the light EMBA. • risk assessment. • mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox and at a minimum will implement: o screens, blinds or window tinting on windows to contain light inside the MODU and support vessels. o outdoor/deck lights when not necessary for human safety or navigation will be turned off. o changes to MODU and vessel lighting that has a cost/benefit. • biological and light monitoring and auditing. • rescue program for if birds land on the MODU or support vessels including advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover: o handling of birds. o releasing of birds. o reporting to DAWE in the case of protected species. The Seabird Lighting Management Plan will be developed and reviewed by an appropriately qualified person.

Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Seasonal timing	Procedure	The activity is planned to be undertaken for a duration of up to 55 days. The following seasonal timings were identified for the species that may be active at night within the light EMBA: • orange-bellied parrot: late February to early April (Australian Museum, 2020). • Common diving petrel: year round (NCVA, 2020). Controls have been identified to ensure lighting on the support vessels and MODU is reduced to that for safe operations. Changing the drilling schedule to avoid the orange-bellied parrot migration is a significant cost to Beach (> $500 million) and not commensurate to the level of impacts predicted. Other species are present all year round or do not forage at night thus changing the period when drilling will occur does not afford any benefit to these species.	No
Implement management actions during the breeding season. Light management should be implemented during the nesting and fledgling periods.	Procedure	The light EMBA is at the closest distance 12 km from islands or a coast where nesting and fledglings may be located. As no impact to nesting or fledglings is predicted the control does not have an environmental benefit.	No
Maintain a dark zone between the rookery and the light sources	Procedure	The light EMBA is at the closest distance 12 km from islands or a coast where rookeries may occur, therefore a dark zone between the rookery and the light sources will be maintained.	Yes
Turn off lights during fledgling season. Use curfews to manage lighting such as extinguish lights around the rookery during the fledgling period by 7 pm as fledglings leave their nest early in the evening.	Procedure	The light EMBA is at the closest distance 12 km from islands or a coast where rookeries may be located. As no impact to fledglings is predicted the control does not have an environmental benefit.	No
Aim lights downwards and direct them away from nesting areas.	Procedure	The light EMBA is at the closest distance 12 km from islands or a coast where nesting may occur. As no impact to nesting areas is predicted the control does not have an environmental benefit.	No
CM#1: National Light Pollution Guidelines for Wildlife Prevent indoor lighting reaching outdoor environment.	Procedure	Use of fixed window screens, blinds or window tinting on windows to contain light inside buildings has the environmental benefit of reducing light emissions from the MODU and support vessels.	Yes

CM#1: National Light Pollution Guidelines for Wildlife Reduce unnecessary outdoor, deck lighting on all vessels and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Procedure	Extinguishing outdoor/deck lights when not necessary for human safety and restrict lighting at night to navigation lights has the environmental benefit of reducing light emissions from the MODU and support vessels.	Yes
CM#1: National Light Pollution Guidelines for Wildlife Vessels working in seabird foraging areas during breeding season should implement a seabird management plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.	Procedure	As the drilling activity will take place when seabird may be foraging or migrating within the light EMBA a Seabird Lighting Management Plan will be developed and implemented as per the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) which will detail: • activity lighting. • seabird population and behaviour within the light EMBA. • risk assessment. • mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox. • biological and light monitoring and auditing. • rescue program for if birds land on the MODU or support vessels. The seabird management plan will be developed by an appropriately qualified	Yes
CM#1: National Light Pollution Guidelines for Wildlife Use flashing/intermittent lights instead of fixed beam. Use motion sensors to turn lights on only when needed. Avoid lights containing short wavelength violet/blue light. Avoid white LEDs. Avoid high intensity light of any colour.	Procedure	Mitigations to manage light, including appropriate use and types of lights, will be reviewed as part of the Seabird Lighting Management Plan (detailed above). Where the Seabird Lighting Management Plan identifies changes to MODU and vessel lighting that has a cost/benefit these mitigations will be implemented.	Yes – where appropriate
Design and implement a rescue program for grounded birds.	Procedure	A rescue program will not prevent birds grounding, but as it has proven useful to reducing mortality of seabirds it has an environmental benefit. The program will include advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover: • handling of birds.	Yes

	• releasing of birds • reporting to DAWE in the case of protected species.
Consequence rating	Moderate (2) with no controls but this would be reduced to Minor (1) with identified controls implemented.
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Light emissions were assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding light emissions.
Other requirements	Light emissions will be managed in accordance with the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). Light emissions are not identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). Light emissions are not identified as a threat in the approved conservation advice for the fairy tern (DSEWPC, 2011c) or the draft recovery plan (DotEE, 2019b). There are no recovery plans, conservation advice or listing advice for the common diving-petrel, short-tailed shearwater or wedge-tailed shearwater. Light emissions will be managed in a manner to not impact on the recovery orange-bellied parrot as per the orange-bellied parrot recovery plan (DELWP, 2016a).
Monitoring and reporting	Impacts associated with light emissions are for a short duration, over small area and not predicted to have long term impacts to fauna in the area. Therefore, the monitoring of light emissions is not proposed.
Acceptability outcome	**Acceptable**

7.3 Atmospheric emissions

7.3.1 Hazards

Atmospheric emissions are generated from combustion engines used on the MODU and vessels.

7.3.2 Known and potential environmental impacts

Atmospheric emissions can lead to a change in air quality and an increase in greenhouse gas emission.

Air emissions may impact receptors such as:

- air quality
- coastal settlements
- seabirds

7.3.3 Consequence evaluation

Air quality impacts are predicted to be localised to the emission point as offshore winds will rapidly disperse atmospheric emission to background levels close to the source.

The extent of the area of impact is predicted to be localised to the emission point as offshore winds will rapidly disperse atmospheric emission to background levels close to the source for a duration of up to 55 days while the activity is undertaken.

There are no coastal settlements within the operational area or at a distance where impacts from air emissions would occur.

Based upon the EPBC Act Policy Statement Indirect Consequence of an Action, the relatively short duration (35 to 55 days) of the activity, GHG emissions from MODU and vessel operations are not a 'substantial cause' of the impact (climate change), therefore climate change is not an indirect consequence of the exploration drilling activity for the purposes of s572E of the EPBC Act.

The operational area overlaps foraging BIAs for several albatrosses, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. The impact to air quality is predicted to be localised to the emission point and can be expected to be reduced to background levels close to the source.

No habitat critical to the survival of birds occur within the operational area. Atmospheric emissions are not identified as a threat in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a).

The extent of the area of impact is predicted to be localised to the emission point as offshore winds will rapidly disperse atmospheric emission to background levels close to the source for a duration of up to 55 days while the activity is undertaken. The severity is assessed as minor based on emissions will rapidly disperse to background levels close to the emission source and it is unlikely that seabirds would be this close to the emission source.

7.3.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Air emissions	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from air emissions are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the impact consequence is rated as minor (1) applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#2: MO 97: Marine Pollution Prevention – Air Pollution	Vessels and MODU will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: • hold a valid International Air Pollution Prevention (IAPP) certificate and a current international energy efficiency certificate. • have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI. • engine NOx emission levels will comply with Regulation 13 of MARPOL 73/78 Annex VI. • sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI.
CM#3: Preventative Maintenance System	Combustion equipment shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
Acceptability assessment	
To meet the principles of ESD	Air emissions were assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding air emissions.

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

7.4 Underwater noise emissions

7.4.1 Hazards

During normal operations the vessels will generate continuous noise from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment.

The MODU does not have self-propulsion so will not generate noise from propellers. Underwater noise emissions from MODUs primarily originate from on-board equipment vibrations, although some emissions are transmitted directly into the water through vibration of the drill string and potentially also from interaction between the drill bits and the seafloor (Austin et al, 2018).

Noise will be generated by helicopters during take-off and landing on the MODU.

7.4.2 Known and potential environmental impacts

Underwater noise emissions from the vessels and MODU may impact biological receptors such as:

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

Potential impacts of underwater noise emissions from the vessels and MODU are:

- behavioural changes; and
- auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

7.4.3 Consequence evaluation

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, 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 are generally higher than further offshore, with a mean of 110 dB re 1 µPa and maximum of 161 dB re 1 µPa (Duncan et al., 2013).

Helicopters may service the MODU up to 7 times per week. The presence of the helicopter and its associated sound field will be highly transient. On approach to the MODU the helicopter will descend to the helideck where there is greatest potential to ensonify the water column. Sound pressure will be greatest at the sea surface and rapidly diminish with increasing depth. Helicopter engine sound is emitted at a range of frequencies generally, below 500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported helicopter sound (for Bell 214 type) being audible in air for four minutes before it passed over receivers, but only detectable underwater for 38 seconds at 3 m depth and for 11 seconds at 18 m depth for the same flight path. Thus, the predicted extent of impact is between 3 to 18 m for a period of 11 – 38 seconds twice a day (landing and take-off). Based on such short-term, intermittent sounds the severity to whales (including pygmy blue whales within the foraging BIA, southern right whales within the current core coastal range and fin or sei whales which also be foraging) and other marine fauna is assessed as minor.

Underwater noise emissions will be generated by the support vessels dynamical position (DP), the action of the drill string whilst drilling and to a lesser extent machinery, pumps and generators on the MODU and vessels (Erbe et al., 2013). The MODU to be used to drill the Artisan-1 well will be an anchored semi-submersible. While drilling one support vessel will be within the operational area (2 km) to support the MODU. This vessel will use DP to maintain position.

7.4.3.1 Noise modelling

Jasco Applied Sciences (Jasco) were contracted to undertake a modelling study of underwater sound levels associated with the Beach Energy Otway Development program. The modelling study considered specific components of the program at two representative development wells, Artisan-1 and Thylacine North-1. The Jasco modelling report (Koessler et al. 2020) is available in Appendix F. This section only details information pertaining to the modelling undertaken at the Artisan-1 location.

The study considered the drilling activities of an anchored MODU conducting drilling operations, and an associated Offshore Support Vessel (OSV), conducting re-supply of the MODU under DP and standing by near the MODU. Four scenarios were modelled, as detailed in Table 7-3.

To assess the cumulative sound field over a 24 h period, an indicative area (2 km wide × 4 km long) in which the OSV could be during standby was defined at the well location. Within the defined area, the vessel was considered to be at randomly seeded locations to best approximate real world activities, and thus approximate representative sound fields for activities. The Jasco modelling report (Appendix F) details the location of the defined area relative to the MODU.

The modelling study 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, these were marine mammals, turtles, and fish (including fish eggs and larvae). 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 (Jasco, 2020).

The modelling methodology considered MODU and vessel specific source levels and range-dependent environmental properties. The Ocean Onyx semi-submersible MODU was used as a proxy for the MODU as it represents the type of MODU that would be used for drilling and abandonment activities. The Siem Offshore Anchor Handling Tug Supply vessel was used as a proxy for a support vessel as it represents the largest type of vessel that may be used to support the MODU. The Jasco modelling report (Appendix F) details the source levels for the MODU and support vessel.

Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), and as accumulated sound exposure levels (SEL, L_E) as appropriate for non-impulsive (continuous) noise sources.

Table 7-3: Acoustic modelling scenarios

Scenario	Description
5	MODU on anchor, normal drilling operations.
6	OSV standing by within 1–3 km of the MODU, ready to respond as required. During this time, the vessel is assumed to be operating under a mix of slow transit, minimal power DP and drifting, and has been conservatively estimated to operating at 15% of the vessels Maximum Continuous Rating (MCR).
7	MODU with OSV during resupply operations. During a 24 h period the resupply operations consist of the following vessel locations and movements: • OSV transiting within the standby area, operating at 15% MCR. • OSV in transit from the standby area to the MODU, operating at 15% MRC (4 knots). • OSV under DP alongside the MODU for a period of 4 hours, operating at 20% MRC. • OSV in transit from the MODU to the standby area, operating at 15% MRC (4 knots).
8	MODU with OSV standby at 15% MCR. Combination of the operation of the MODU with the OSV keeping station in the defined area over 24 h, representing drilling operations with typical support vessel activity.

7.4.3.2 Marine Mammals PTS and TTS

The US National Marine Fisheries Service (NMFS 2018) reviewed available literature to determine exposure criterion for temporary hearing threshold shift (TTS) and injury, referred to as the onset of non-recoverable permanent hearing loss (permanent threshold shift [PTS]) for marine mammals based on their frequency hearing range. 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 h. Table 7-4 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 h criteria was applied to marine mammals that may be undertaking biologically important behaviours, such as calving, foraging, resting or migration (as defined by Commonwealth of Australia, 2015c), that could result in them being within the ensonification area above the PTS and TTS criteria for a period of 24 h or greater.

Table 7-4: Cetacean PTS and TTS noise criteria and predicted distances and areas

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

Hearing group	SEL_{24h} Threshold ($L_{E,24h}$; dB re 1 µPa²·s) #	MODU (Scenario 5)		OSV standby (Scenario 6)		MODU and OSV resupply (Scenario 7)[B]		MODU and OSV standby (Scenario 8)[B]	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS									
LF cetaceans	199	–	–	–	–	–	–	–	–
MF cetaceans	198	–	–	–	–	–	–	–	–
HF cetaceans	173	0.04	0.005	–	–	0.04	0.005	0.04	0.005
Phocid Seals	201	–	–	–	–	–	–	–	–
Otariid Seals	219	–	–	–	–	–	–	–	–
Turtles	220	–	–	–	–	–	–	–	–
TTS									
LF cetaceans	179	0.92	2.49	1.12	8.21	2.73[C]	15.5	2.76[C]	13.9
MF cetaceans	178	–	–	–	–	–	–	–	–
HF cetaceans	153	0.60	1.09	1.04	4.23	2.68[C]	6.05	1.04[A]	4.23
Phocid Seals	181	0.21	0.11	–	–	0.21	0.11	0.21	0.11
Otariid Seals	199	–	–	–	–	–	–	–	–
Turtles	200	–	–	–	–	–	–	–	–

\# Frequency weighted.
[A] Radial distance reported from the centre of the OSV standby area.
[B] Radial distance reported from the centre of the MODU, unless indicated otherwise.
[C] Radial distance reported from the mid-point between the MODU and the centre of the OSV standby area.

Phocid seals

The Phocid seal PTS criteria was not reached and the furthest distance to TTS criteria is 0.21 km. The PMST Report (Appendix A.2 Operational Area 2 km) identified the Australian and New Zealand fur-seals, however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

Otariid seals

The Otariid seal PTS and TTS criteria were not reached and is not assessed further.

High-frequency cetaceans

The furthest distance to the high-frequency cetacean PTS criteria is 0.04 km and the TTS criteria is 2.68 km. The PMST Report (Appendix A.4 Noise 24 hr EMBA 3 km) did not identify any high-frequency cetaceans such as pygmy and dwarf sperm whales, therefore they are not assessed further.

Mid-frequency cetaceans

The mid-frequency cetacean PTS and TTS criteria were not reached and is not assessed further.

Low-frequency cetaceans

The low-frequency cetacean PTS criteria is not reached and the further distance to the TTS criteria is 2.76 km and the largest area is 15.5 km^2. Table 7-5 details the low-frequency cetaceans that have biologically important areas or biologically important behaviours. These were identified from the PMST Reports (Appendix A.4 Noise 24 hr EMBA 3 km) and BIAs (Table 5-11). As part of this review it was identified that the southern right whale current core coastal range is within the ensonification area above the PTS and TTS criteria though this is not a biologically important areas and no biologically important behaviours occur the southern right whale has been included in this assessment as a conservative measure.

Table 7-5: 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. As detailed in Section 5.7.7.6 cetacean foraging within the Otway shelf, and hence the area where the PTS and TTS criteria is reached, is typically from January to April which potentially overlaps the period when drilling may occur.

The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. The conservation plan identifies shipping and industrial noise, which includes drilling activities, 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 pygmy blue whales are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

The area of impact is small with the further distance of 2.76 km from the combined noise from the MODU and support vessel for the TTS criteria. At any one time the largest area of impact would be 15.5 km^2 which equates to 0.043% of the pygmy blue whale high density foraging BIA (35,627 km^2).

The southern right whale current core coastal range is within the ensonification area above the TTS criteria. As detailed in Section 5.7.7.6, there is the potential for southern right whales to be transiting through the area during May-June and September-November as they move to and from areas.

The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise, which includes drilling activities, 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.

As the closest distance to a southern right whale current core coastal range where biologically important behaviour , such as calving, foraging, resting or migration (as defined by Commonwealth of Australia, 2015c) occurs is 27 km from the Artisan-1 well (Figure 7-15), TTS and PTS are not assessed for these areas as impacts are not predicted.

The area of impact is small with the furthest distance of 2.76 km from the combined noise from the MODU and support vessel for the TTS criteria. At any one time the largest area of impact would be 15.5 km^2 which equates to ~0.007% of the southern right whale current core coastal range (217,825 km^2).

The fin, pygmy blue and sei whales do not have conservation management plans. The fin and sei whales have conservation advice (TSSC, 2015f; TSSC, 2016g) which both identify anthropogenic noise as a threat with the conservation and management actions of:

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

The fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large. There is no conservation advice for the pygmy right whale and the Species Profile and Threats Database (DotEE, 2020a) does not identify anthropogenic noise and acoustic disturbance as a threat.

The furthers extent of impact is predicted to be a distance of 2.76 km from a support vessel and from the MODU with the greatest area of impact of 15.5 km^2 for a duration of up to 55 days while drilling is undertaken. The severity is assessed as moderate and is of an acceptable level based on:

- a conservative approach has been taken in applying the sound modelling and results such as:
    - using the June sound speed profile which is expected to be most favourable to longer-range sound propagation across the entire year. As such, June was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds.
    - using the further distance to the PTS and TTS criteria for the scenarios modelled to assess potential impacts.
    - drilling will not consistently occur for a period of 24 hours for 55 days as the timing takes into account downtime when drilling is not occurring.
- PTS impacts to seals, low-frequency and mid-frequency cetaceans were not predicted. The maximum distance to the PTS criteria for high-frequency cetaceans is predicated to be 40 m, however no high-frequency cetaceans were identified from the PMST Report.
- adopted controls as detailed in Section 7.4.4 will prevent possible PTS or TTS impacts to whales that may be foraging or moving through the area.
- the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that shipping and industrial noise, which includes drilling activities, are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.
- the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that "It is the high intensity signals with high peak pressures received at very short range that can cause acute impacts such as injury and death." As vessel and MODU noise are continuous noise sources and do not have high intensity signals it is unlikely that they would cause injury to foraging pygmy blue whales.

- though the well may be drilled during the period when pygmy blue whales are likely to be foraging within the BIA (January through to April (Gill et al., 2011) the largest area of potential impact within the BIA is very small at 0.043% of the pygmy blue whale high density foraging BIA.

- the TTS ensonification area is ~82 km from the Bonney coast upwelling KEF which is a known feeding aggregation area (Gill et al. 2011; McCauley et al. 2018). The TTS ensonification area is within an area where the occurrence of an upwelling event between 2002 and 2016 was assessed as unlikely with an upwelling frequency of <10% (Huang and Wang 2019 see Section 5.6.9 Bonney coast upwelling). Thus, pygmy blue and other whale foraging is likely to be opportunist within the TTS ensonification 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.

- though low numbers of blue whales are predicted within the TTS ensonification area based on the following, an adaptive management program as detailed in Section 7.4.4 will be implemented to take into account seasonal fluctuations in upwellings in the Otway area:

  - the TTS ensonification area is ~82 km from the Bonney coast upwelling 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 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 <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 (Victorian Government Department of Sustainability and Environment 2009).

  - the seabed site assessment undertaken by Fugro (Fugro, 2019; Ramboll, 2020. Appendix E) did not identify any seabed features that would provide for upwellings where congregations of krill are likely to occur.

  - pygmy blue whales are not resident, rather they are migrating between feeding areas (Perth Canyon and Bonney coast upwelling), northwards and southwards along the west coast of Australia, to breeding grounds in Indonesia (Commonwealth of Australia, 2015c). The distribution of pygmy blue whales at the Bonney coast upwelling KEF and adjacent waters changes within a season and is dependent on the local prevalence of environmental conditions that are favourable to krill (Commonwealth of Australia, 2015c). Attard et al. (2017) also noted that movement between localities may also be promoted by the inter-annual variability in the density and distribution of blue whale prey. Garcia et al. (2018) details that blue whales are known to aggregate and feed in regions where dynamic oceanographic processes promote patchy but dense aggregations of prey (krill). Gill et al. (2011) detailed that blue whale distribution and relative abundance were fluid through the study region (southern Australia) during all months of the feeding season. Thus, though feeding is typically more abundant within the Bonney coast upwelling KEF there is no singular or regular "hot spot" in adjacent waters such as within the TTS ensonification area. Dynamic oceanographic processes that promote aggregations of krill may occur within the TTS ensonification area, as it may in any other areas within the high density foraging BIA, thus pygmy blue whales are not anticipated in high numbers during the January through to April foraging period.

- the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) details that shipping and industrial noise, are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.
- though the well may be drilled during the period when southern right whales are within the current core coastal range the area of potential impact is very small (0.007%) compared to the large area of the current core coastal range.
- there is no overlap with southern right whale BIAs where biologically important behaviours such as calving, foraging, resting or migration (as defined by Commonwealth of Australia, 2015c).
- southern right whales' movement 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) that recorded 12 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. Though low numbers of southern right whales are predicted within the TTS ensonification area an adaptive management program, as detailed in Section7.4.4 will be implemented if numbers are greater than predicted.
- the fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.
- the pygmy right whale Species Profile and Threats Database (DotEE, 2020a) in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat.
- low numbers of fin, sei and pygmy right whales are predicted within the TTS ensonification area based on the following, however, an adaptive management program, as detailed in Section7.4.4, will be implemented to take into account seasonal fluctuations in upwellings in the Otway area:
    - the TTS ensonification area is ~82 km from the Bonney coast upwelling KEF which is known as feeding aggregation areas (Gill et al. 2011; McCauley et al. 2018).
    - the TTS ensonification area is within an area with a historical frequency <10% of an upwelling occurring (Huang and Wang 2019).
    - no biologically important areas were identified for these species.
    - aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of 8 individuals, 12 sei whale sightings consisting of 14 individuals and one pygmy right whale sighting consisting of 100 individuals (Gill et al. 2015). Gill et al. (2015) did observer feeding behaviour for sei and fin whales but noted that it is at least an opportunistic feeding area for these species.
    - the seabed site assessment undertaken by Fugro (Fugro, 2019; Ramboll, 2020. Appendix E) did not identify any seabed features that would provide for upwellings where congregations of krill are likely to occur.
    - fin, sei and pygmy right whales are not resident in the area and as detailed for pygmy blue whales their distribution would be throughout the Bonney coast upwelling KEF and adjacent waters based on where krill aggregations occur.

7.4.3.3 Marine mammals behaviour

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. The current interim NFMS (NOAA 2019) criterion of 120 dB re 1 µPa for non-impulsive sound sources such as vessels and MODUs is used as the marine mammal behavioural criteria for this assessment as it represents a conservative criterion as Southall et al. (2007) reviewed extensive literature and studies in relation to marine mammal behavioural response to impulsive (seismic, pile driving) and non-impulsive (drilling, vessels) and found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa.

The NFMS (NOAA 2019) behavioural criteria and predicted distance for each scenario is detailed in Table 7-6. The furthest distance of 17.4 km has been used to define the noise behaviour EMBA (20 km) to identify potential receptors. Note the noise behaviour EMBA is the same as the Light EMBA.

The distance of 17.4 km is only predicted when then MODU is being resupplied by the support vessel which is required to use DP to hold station next to the MODU. This would typically occur for a period of 1 – 2 hours every couple of days with potentially a longer period of up to 4 hours for refuelling or transfer of bulk material every one to two weeks. Typically, the support vessel will be on standby for the MODU and hence the distance modelled for Scenario 8 of 9.94 km is a more representative of day to day activities.

Table 7-6: Cetacean behavioural noise criteria and predicted distances and areas

SPL (Lp; dB re 1 µPa)	MODU (Scenario 5)		OSV standby (Scenario 6)		MODU and OSV resupply (Scenario 7)[A]		MODU and OSV standby (Scenario 8)[Bi]	
	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)
120	5.91	94.3	6.23	105	17.4	764	8.94	202

A: Radial distance reported from the mid-point between the MODU and the OSV on DP in resupply operations
B: Radial distances for isopleths/thresholds that envelope the MODU and OSV were reported from the mid-point between the MODU and the centre of the OSV standby area. Otherwise radial distances reported from the centre of standby area.

Within the noise behaviour EMBA the following have been identified:

- nine whale species, five dolphin species and two fur-seal species may be present based on the noise behaviour EMBA PMST Report (Appendix A.3).
- foraging behaviour for the blue (known to occur), fin (likely to occur), pygmy right (may occur) and sei whales (likely to occur) as detailed in the noise behaviour EMBA PMST Report (Appendix A.3). As detailed in Section 5.7.7.6 cetacean foraging within the Otway shelf, and hence within the noise behaviour EMBA, is typically from January to April which overlaps the drilling period.
- pygmy blue whale foraging BIA (Figure 7-17). As detailed in Section 5.7.7.6 cetacean foraging within the Otway shelf, and hence within the noise behaviour EMBA, is typically from January to April which overlaps the drilling period.
- southern right whale current core coastal range (Figure 7-15). As detailed in Section 5.7.7.6 southern right whales move through the area during May and June, which overlaps the drilling period, as they move towards coastal aggregation and migration areas.
- no habitats critical to the survival of the species were identified.

The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. The conservation plan details that shipping and industrial noise, which includes drilling activities, are classed as a minor consequence where individuals are affected but no affect 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 possible consequences.

The further distance to the behaviour noise criteria of 17.4 km when resupply is occurring equates to an area of 764 km^2 which is 2.1% of the pygmy blue whale high density foraging BIA (35,627 km^2). However, for most of the time when the support vessel is on standby the distance to the behaviour noise criteria is 8.94 km (202 km^2) which is 0.57% of the pygmy blue whale high density foraging BIA (35,627 km^2).

The foraging BIA is not restricted, and the noise behaviour EMBA is 13.6 km (based on 31 km from the Artisan-1 well less the 17.4 km noise behaviour EMBA) to the nearshore boundary of the BIA and 48.6 km (based on 66 km from the Artisan-1 well less the 17.4 km noise behaviour EMBA) to the offshore boundary of the high density foraging BIA (Figure 7-17). This distance would provide enough space to ensure pygmy blue whales that may avoid noise behaviour EMBA are not displaced from the BIA.

The fin, pygmy blue and sei whales do not have conservation management plans. The fin and sei whales have conservation advice (TSSC, 2015f; TSSC, 2016g) which both identify anthropogenic noise as a threat with the conservation and management actions of:

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

The fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large. There is no conservation advice for the pygmy right whale and the Species Profile and Threats Database (DotEE, 2020a) does not identify anthropogenic noise and acoustic disturbance as a threat.

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 cited in DotEE, 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 the area of occupancy of pygmy right whales cannot be calculated due to the paucity of records for pelagic waters off Australia and the subAntarctic (DotEE, 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 south-west 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 ~65.6 km (~83 km from the Artisan-1 well less 17.4 km see Figure 5-9) from the noise behaviour EMBA. Opportunistic foraging may occur within the noise behaviour EMBA, however, the area of disturbance is small at 17.4 km with an area of 764 km^2 that may be avoided by fin, pygmy blue and sei whales in an area where there are no BIAs or known area of occupancy for these species.

The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise, which includes drilling activities, 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 (as defined by Commonwealth of Australia, 2015c) occur is 9.6 km from the noise behaviour EMBA (based on 27 km from the Artisan-1 well to the migration BIA less 17.4 km from the noise behaviour EMBA) (Figure 7-15). As this is outside of the noise behaviour EMBA impacts to these areas are not predicted.

An emerging aggregation area has been identified at Port Campbell (Figure 5-35). This area 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. 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, which is a greater distance than the distance to 20 m water depth (see Figure 7-16), the noise behaviour EMBA is 11.6 km (based on Artsian-1 well is 31 km to Port Campbell less 2 km for the aggregation area less 17.4 km for the noise behaviour EMBA) from the area of potential occupancy for the Port Campbell emerging aggregation area, thus impacts to this area are not predicted.

The noise behaviour EMBA is located within the southern right whale current core coastal range. As detailed in Section5.7.7.6 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 Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) details that exactly where whales approach and leave the Australian coast from, and to, offshore areas is not well understood and that more-or-less direct approaches and departures to the coast are also likely.

The further distance to the behaviour noise criteria of 17.4 km when resupply is occurring which equates to an area of 764 km^2 which is ~0.35% of the southern right whale current core coastal range (217,825 km^2). However, for most of the time when the support vessel is on standby the distance to the behaviour noise criteria is 8.94 km (202 km^2) which is ~0.092% of the southern right whale current core coastal range (217,825 km^2).

The extent of impact is predicted to be a distance of 8.94 km when the support vessel is on standby with the MODU and 17.4 km when the support vessel is resupplying the MODU. This equates to an area of impact of 202 km^2 to 894 km^2 for a duration of up to 55 days. The severity to marine mammals is assessed as moderate based and is of an acceptable level based on:

- a conservative approach has been taken in applying the sound modelling and results such as:
  - using the June sound speed profile which is expected to be most favourable to longer-range sound propagation across the entire year. As such, June was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds.
  - the further distance to the NMFS noise behaviour criteria for the scenarios modelled has been used to assess potential impacts. Resupply would typically occur for a period of 1 – 2 hours every couple of days with potentially a longer period of up to 4 hours for refuelling or transfer of bulk material every one to two weeks. Typically, the support vessel will be on standby for the MODU and hence the distance modelled for Scenario 8 of 8.94 km is a more representative of day to day activities.
  - drilling will not consistently occur for 55 days as the timing takes into account downtime when drilling is not occurring.

- an extensive review of behavioural responses to sound undertaken by Southall et al. (2007) identified varying responses for most marine mammals between a SPL of 140 and 180 dB re 1 µPa, Based on the Jasco acoustic modelling (Appendix F) 180 dB re 1 µPa is only reached for the resupply scenario at a distance of 30 m from the MODU and 140 dB re 1 µPa was reached at a maximum distance of 1.6 km, for the resupply scenario. During day to day operations 140 dB re 1 µPa was reached at a maximum distance of 370 m for the MODU and support vessel on standby.

- the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that shipping and industrial noise, which includes drilling activities, are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.

- though the well may be drilled during the period when pygmy blue whales are likely to be foraging within the foraging BIA (January through to April (Gill et al., 2011) the area of potential impact is small at 2.1% of the pygmy blue whale high density foraging BIA when resupply is occurring and 0.57% during normal operations.

- the pygmy blue whale high density foraging BIA is not restricted, and the maximum extent of impact is 17.4 km when resupply is occurring, which is 13.6 km to the nearshore boundary of the BIA and 48.6 km to the offshore boundary of the high density foraging BIA (Figure 7-17) allowing sufficient space to ensure pygmy blue whales that may avoid the noise EMBA where noise levels are potentially above the behavioural response criteria are not displaced from the BIA. This is a conservative approach based on:

  - resupply would typically occur for a period of 1 – 2 hours every couple of days with potentially a longer period of up to 4 hours for refuelling or transfer of bulk material every one to two weeks. Typically, the support vessel will be on standby for the MODU and hence the distance modelled for Scenario 8 of 8.94 km is a more representative of day to day activities.

  - an extensive review of behavioural responses to sound undertaken by Southall et al. (2007) that identified varying responses for most marine mammals to continuous sounds between a SPL of 140 and 180 dB re 1 µPa, thus, it more likely that whales would avoid the area at noise levels above 140 dB re 1 µPa which based on the Jasco acoustic modelling would be a maximum of 1.6 km when resupplying and 370 m for day to day activities where the support vessel is on standby for the MODU. This allows a greater area to ensure pygmy blue whales are not displaced from the BIA.

- the noise behaviour EMBA is over ~65 km from the Bonney coast upwelling KEF which is a known feeding aggregation area (Gill et al. 2011; McCauley et al. 2018). The noise behaviour EMBA 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 see Section 5.6.8 Bonney coast upwelling). Thus, pygmy blue and other whale foraging is likely to be opportunist within the noise behaviour EMBA. 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.

- Thus, pygmy blue and other whale foraging is likely to be opportunist within the noise EMBA. Attard et al. (2017) showed that pygmy blue whales travel widely between the two known foraging areas (Bonney 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.

- though low numbers of blue whales are predicted within the noise behaviour EMBA based on the following, an adaptive management program as detailed in Section 7.4.4 will be implemented to take into account seasonal fluctuations in upwellings in the Otway area:
  - the noise behaviour EMBA is ~65 km from the Bonney coast upwelling 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 the KEF has an upwelling frequency of 30 – 50% which is classed as seasonal (Huang and Wang 2019). The noise behaviour EMBA is within an area with a historical frequency <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 (Victorian Government Department of Sustainability and Environment 2009).
  - the seabed site assessment undertaken by Fugro (Fugro, 2019; Ramboll, 2020. Appendix E) did not identify any seabed features that would provide for upwellings where congregations of krill are likely to occur.
  - pygmy blue whales are not resident, rather they are migrating between feeding areas (Perth Canyon and Bonney coast upwelling), northwards and southwards along the west coast of Australia, to breeding grounds in Indonesia (Commonwealth of Australia, 2015c). The distribution of pygmy blue whales at the Bonney coast upwelling system and adjacent waters changes within a season and is dependent on the local prevalence of environmental conditions that are favourable to krill (Commonwealth of Australia, 2015c). Attard et al. (2017) also noted that movement between localities may also be promoted by the inter-annual variability in the density and distribution of blue whale prey. Garcia et al. (2018) details that blue whales are known to aggregate and feed in regions where dynamic oceanographic processes promote patchy but dense aggregations of prey (krill). Gill et al. (2011) detailed that blue whale distribution and relative abundance were fluid through the study region (southern Australia) during all months of the feeding season. Thus, though feeding is typically more abundant within the Bonney coast upwelling there is no singular or regular "hot spot" in adjacent waters such as within the noise behaviour EMBA. This is supported by Huang and Wang (2019) that identified that the area where the noise behaviour EMBA is has a historical frequency of <10% of an upwelling occurring. Though dynamic oceanographic processes that promote aggregations of krill may occur within the noise behaviour EMBA, as it may in any other areas within the high density foraging BIA, there is no features that would make it an area where this would repeatedly occur during the period where the activity overlaps the January through to April foraging period.
- the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) details that shipping and industrial noise, are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.
- though the well may be drilled during the period when southern right whales may be travelling through the noise behaviour EMBA to coastal aggregation and migration areas the area of potential impact is small at 0.35% of the southern right whale current core coastal range during resupply and 0.092% for most of the time when the support vessel is on standby.
- the closest distance to a southern right whale BIA where biologically important behaviour, such as calving, foraging, resting or migration (as defined by Commonwealth of Australia, 2015c) occur is 9.6 km from the noise behaviour EMBA (Figure 7-15). As this is outside of the noise behaviour EMBA impacts to these BIAs are not predicted.

- the noise behaviour EMBA is 11.6 km from the area of potential occupancy Port Campbell southern right whale emerging aggregation area (Figure 7-16) thus impacts to this area are not predicted.
- southern right whales may avoid the noise behaviour EMBA but there is no impediment to them continuing to the coastal aggregation and migration areas. Southern right whales are a highly mobile migratory species which travel thousands of kilometres between habitats used for essential life functions (DSEWPaC, 2012a). On the Australian coast individual southern right whales use widely separated coastal areas (200–1500 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). Based on this information that southern right whales travel substantial distances in a season, avoidance of the noise EMBA (maximum of 17.4 km distance) is unlikely to prevent them from reaching coastal aggregation and migration areas. This is a conservative approach based on:
  - a maximum distance of 15.4 km is based on the resupply scenario which would typically occur for a period of 1 – 2 hours every couple of days with potentially a longer period of up to 4 hours for refuelling or transfer of bulk material every one to two weeks. Typically, the support vessel will be on standby for the MODU and hence the distance modelled for Scenario 8 of 8.94 km is a more representative of day to day activities.
  - an extensive review of behavioural responses to sound undertaken by Southall et al. (2007) that found varying responses for most marine mammals to continuous sounds between a SPL of 140 and 180 dB re 1 µPa. It is more likely that whales would avoid the area at noise levels above 140 dB re 1 µPa which based on the Jasco acoustic modelling (Appendix F) is only reached for the resupply scenario at a distance of 30 m from the MODU and 140 dB re 1 µPa was reached at a maximum distance of 1.6 km, for the resupply scenario. During day to day operations 140 dB re 1 µPa was reached at a maximum distance of 370 m for the MODU and support vessel on standby. This reduces the distance that southern right whales may avoid when moving through the area.
- low numbers of southern right whales are predicted within the noise behaviour EMBA based on aerial surveys in the Otway region (2002 – 2013) that recorded 12 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. Though low numbers of southern right whales are predicted within the noise behaviour EMBA an adaptive management program, as detailed in Section 7.4.4, will be implemented if numbers are greater than predicted.
- the fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.
- the pygmy right whale Species Profile and Threats Database (DotEE, 2020a), in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat.
- low numbers of fin, sei and pygmy right whales are predicted within the noise behaviour EMBA based on the following, however, an adaptive management program, as detailed in Section 7.4.4, will be implemented to take into account seasonal fluctuations in upwellings in the Otway area:
  - the noise behaviour EMBA is ~66 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 noise behaviour EMBA is within an area with a historical frequency <10% of an upwelling occurring (Huang and Wang 2019).

- no biologically important areas were identified for these species.
- aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of 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) did observe feeding behaviour for sei and fin whales but noted that it is at least an opportunistic feeding area for these species.
- the seabed site assessment undertaken by Fugro (Fugro, 2019; Ramboll, 2020. Appendix E) did not identify any seabed features that would provide for upwellings where congregations of krill are likely to occur.

- there are no habitats critical to the survival of the species for marine mammals within the noise behaviour EMBA.

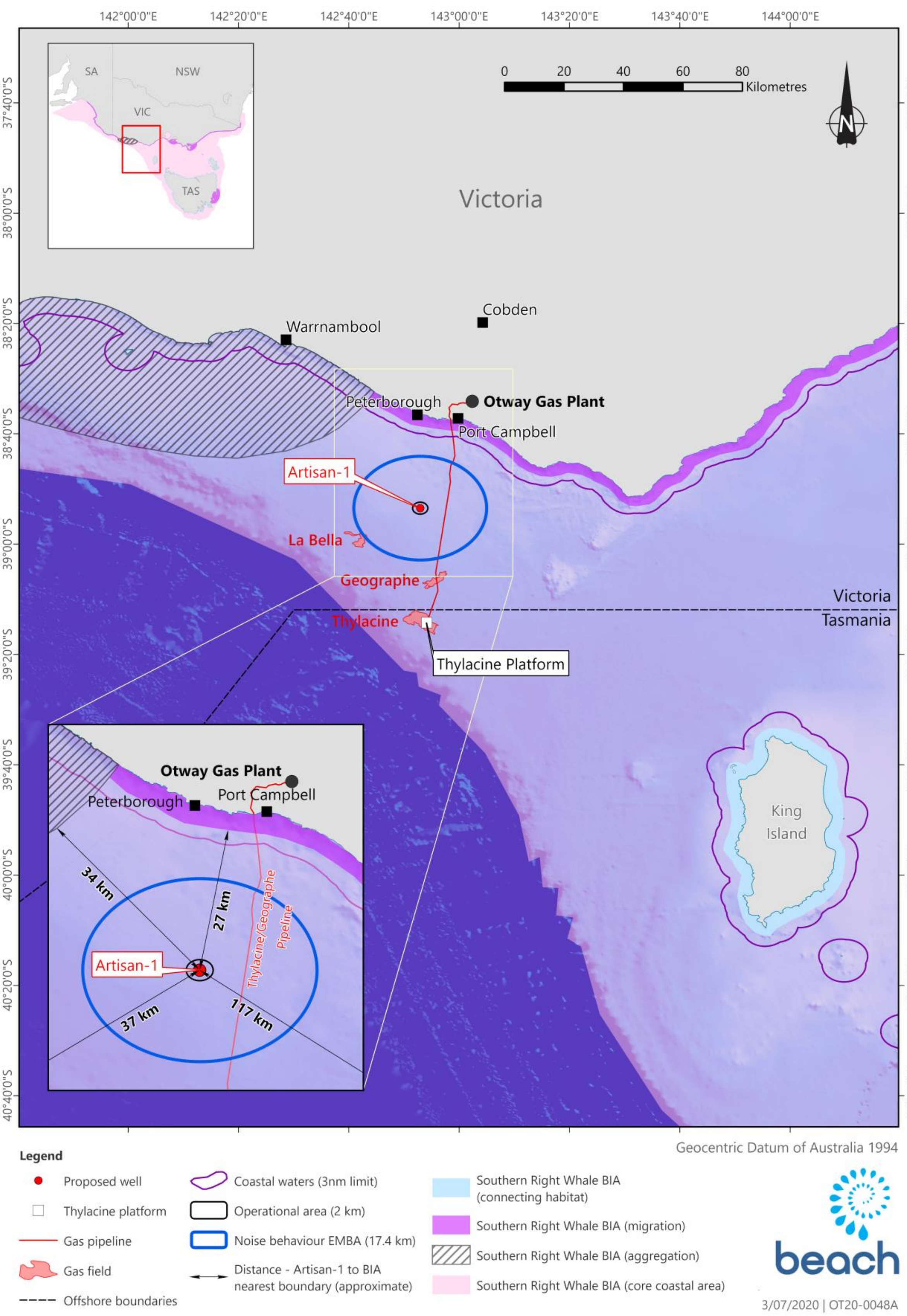

Figure 7-15: Southern right whale BIAs and noise behaviour EMBA

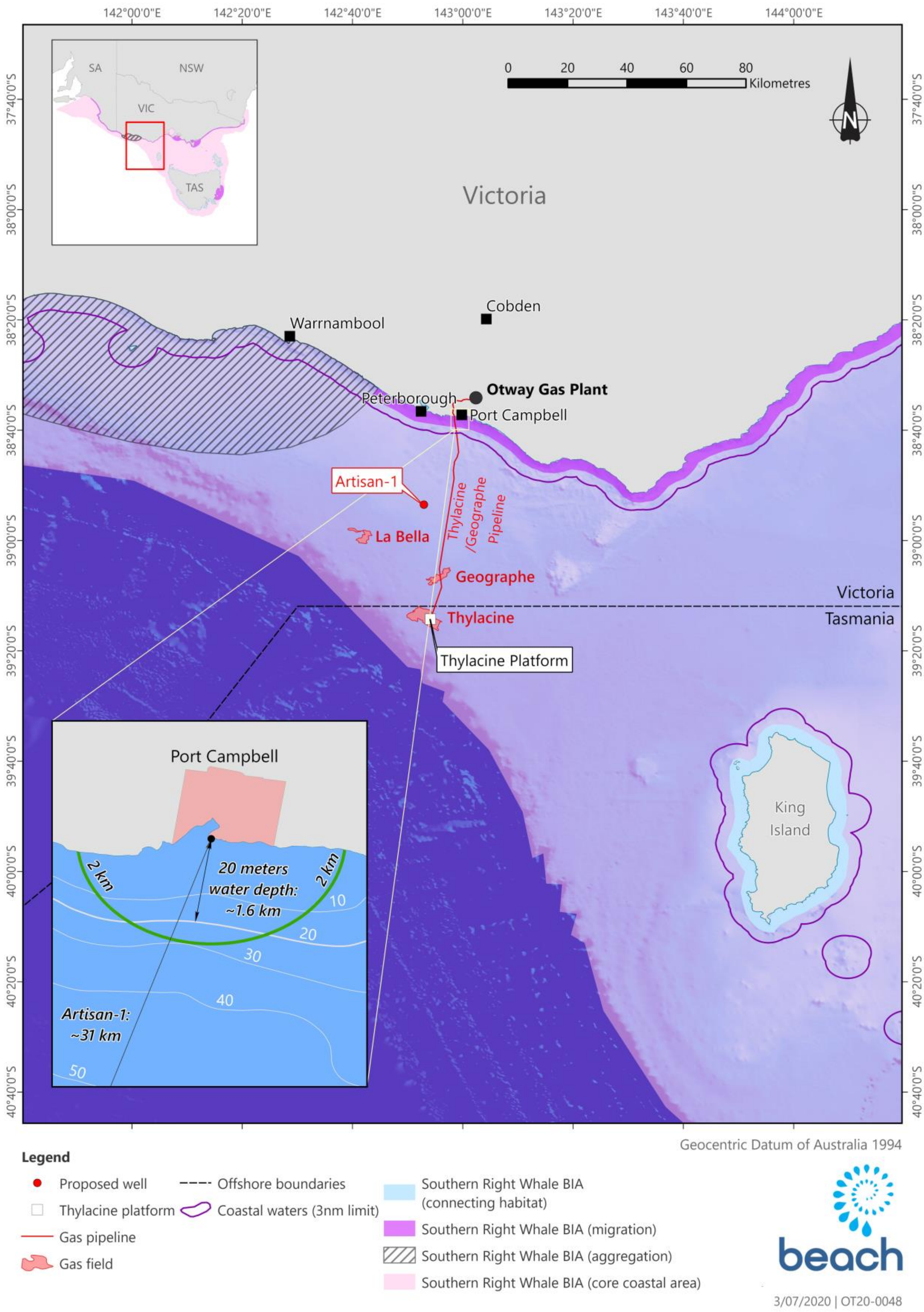

Figure 7-16: Southern right whale emerging aggregation area distances

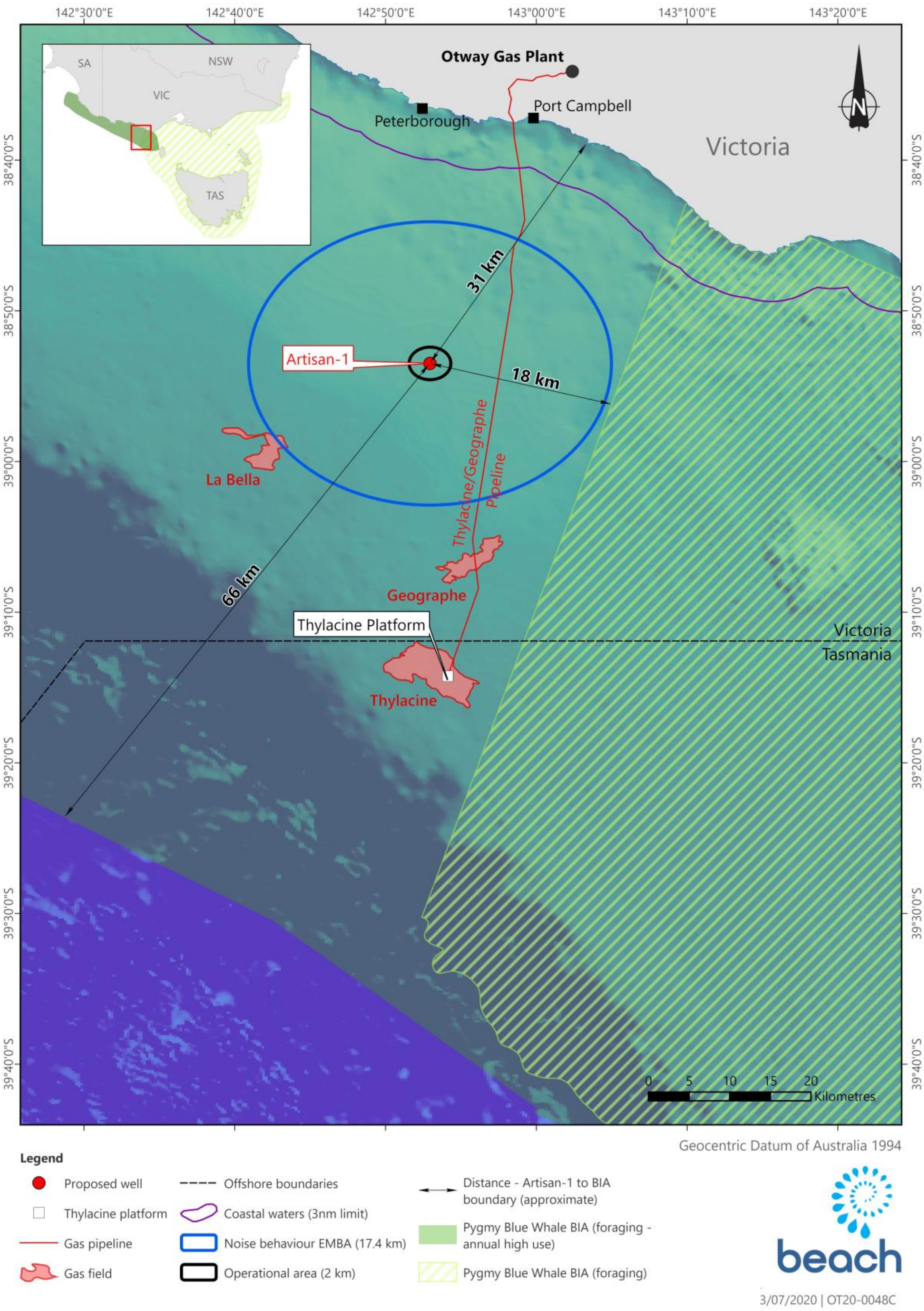

Figure 7-17: Pygmy blue whale BIAs and noise behaviour EMBA

7.4.3.4 Marine Turtles

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

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to develop noise exposure criteria for fish and turtles. The Working Group developed guidelines with specific thresholds for different levels of effects for several species groups including turtles (Popper et al. 2014).

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

There are currently no quantitative exposure guideline or criteria for marine turtles for continuous sound such as those generated by vessels and the MODU. Popper et al. (2014) found that there was insufficient data available and instead suggested general distances to assess potential impacts. Using semi-quantitative analysis, Popper et al. (2014) suggests that there is a low risk to marine turtles from shipping and continuous sound except for TTS near (10s of metres) to the sound source, and masking at near, intermediate (hundreds of metres) and far (thousands of metres) distances and behaviour at near and intermediate distances from the sound source. Based on this information avoidance behaviour may occur within the operational area (2 km).

Finneran et al. (2017) presented revised thresholds for turtle PTS and TTS for continuous sound, however, these were not predicted to occur within the modelling resolution (Jasco, 2020. Appendix F).

Three marine turtle species may occur within the operational area and EMBA though no BIAs or habitat critical to the survival of the species were identified.

The extent of the area of impact is predicted to be within the operational area for a duration of up to 55 days while the MODU and vessels are on location. The severity is assessed as minor based on:

- the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat and no marine turtle important habits are located within the area that maybe impacted.
- thresholds for turtle PTS and TTS Finneran et al. (2017) were not predicted to occur within the modelling resolution.
- avoidance behaviour may occur within the operational area where no marine turtle important habits are located.
- low numbers of marine turtles are predicted in the operational area and therefore impacts would be limited to a small number of individuals.

7.4.3.5 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 temporary threshold shift (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 and Popper et al. (2014) details SPL criteria for fish with a swim bladder involved in hearing. Table 7-7 details the criteria and modelled distances to them.

Table 7-7: SPL criteria for fish with a swim bladder involved in hearing and modelled distances

Fish: Swim bladder involved in hearing	SPL (Lp; dB re 1 µPa)	MODU (Scenario 5)	OSV standby (Scenario 6)	MODU and OSV resupply (Scenario 7[ii])	MODU and OSV standby (Scenario 8)[ii]
		R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)
Recoverable injury	170 dB SPL for 48 h	Not reached	Not reached	0.03	Not reached
TTS	158 dB SPL for 12 h	Not reached	Not reached	0.09	Not reached

No cumulative impacts are expected as there are no habitats likely to support site-attached fish in the operational area.

The 48 hr recoverable injury criteria was only reached within 30 m for when the support vessel is resupplying the MODU and is under DP at the MODU. Typical resupply is ~ 4 hours with resupply for 48 hours unlikely. As there are no habitats likely to support site-attached fish in the operational area it is also unlikely that fish species would be present for a period of 48 hours. Thus, recoverable injury impacts are not predicted.

The 12 hr TTS criteria was only reached within 90 m for when the support vessel is resupplying the MODU and is under DP at the MODU. Typical resupply is ~ 4 hours with resupply for 12 hours unlikely. As there are no habitats likely to support site-attached fish in the operational area it is also unlikely that fish species would be present for a period of 12 hours. Thus, TTS impacts are not predicted.

Behavioural impacts are more likely such as moving away from the MODU and vessels. There are no habitats or features within the operational area that would restrict fish and sharks from moving away from the MODU or vessels.

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

No commercial fishing for fish species were identified within the operational area. Thus, impacts to commercial fisheries are not predicted.

The extent of the area of impact is predicted to be within the operational area for a duration of up to 55 days while the MODU and vessels are on location. The severity is assessed as minor based on:

- the Recovery Plan for the white shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify noise impacts as a threat.
- avoidance behaviour may occur within the operational area, however, no habitats likely to support site-attached fish have been identified within the operational area.
- no commercial fishing for fish species were identified within the operational area.

7.4.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Underwater noise emissions	
ALARP decision context and justification	**ALARP Decision Context: Type B** Impacts from noise emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
CM#4: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels and helicopters. Typically, vessel follow the EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans. These regulations stipulate a safe operating distance of 300 m. As the activity may be undertaken within the period that blue, fin, pygmy right and sei whales have been identified as foraging (January through to April) and southern right whales may be travelling through the area to coastal aggregation and migration areas (May-June and September-November) the safe operating distance to whales will be increased to 1.2 km when vessels are within the operational area which is covered by this EP. The PTS criteria for low-frequency cetaceans from the support vessel is not reached. The TTS criteria for low-frequency cetaceans such as blue, fin, pygmy right, sei and southern right whales, is predicted to be 1.12 km from the support vessel. If the support vessel maintains a distance of 1.2 km to whales, they will not be significantly impacted (injured) by the noise generated by the support vessel. Using 1.2 km adds a level of conservatism to the safe operating distance. As the TTS criteria is determined over a 24 hour period the vessel would need to be within 1.12 km of a whale for 24 hours for TTS impacts to occur. Thus, night time surveillance is not required to ensure whales that may be in the area for 24 hours are not impacted. By the vessel maintaining a 1.2 km distance from whales this would also mitigate the risk of significant impact to whales from the combined MODU and support vessel when the vessel is on standby. To mitigate the risk of significant impact to whales from the combined MODU and support vessels when resupply is occurring a pre-start observation will be undertaken as detailed in CM#5.
CM#3: Preventative Maintenance System	Power generation and propulsion systems on the vessels and MODU will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.
CM#5: Pre-start drilling and resupply observations	It is unlikely that whales would come into the area where noise levels are above the PTS and TTS criteria once the MODU and vessel are on location. However, they may be disturbed if they are already foraging or present in the area. To ensure whales undertaking biologically important behaviour such as foraging, or when traversing through the area to and from coastal

		aggregation areas are not impacted from these drilling activities, pre-start observations will be implemented: • observations by a person who has proven experience in whale observation, distance estimation and reporting will be undertaken for 30 minutes from the MODU to 1 km prior to commencing drilling. If whales are present within the 1 km zone drilling will not commence until they have moved outside the 1 km zone or 30 minutes has lapsed since the last whale sighting within 1 km. • observations by a person who has proven experience in whale observation, distance estimation and reporting will be undertaken for 30 minutes from the MODU to 3 km prior to commencing resupply operations. If whales are present within the 3 km zone resupply will not commence until the whale/s have moved outside the 3 km zone or 30 minutes has lapsed since the last whale sighting within 3 km. • drilling or resupply is unlikely to commence at night, however, in the event that it is required it may only occur if there have been no whales sighted within the corresponding observations zones in the preceding daylight hours. Commencing drilling or resupply at night if no whales have been sighted within the corresponding observations zones in the preceding daylight hours is acceptable as the MODU would have been on location for a period of time prior to the activity commencing so the presence of whales within the observation zones would be known. 1 km is deemed an appropriate distance for the MODU based on the modelled distance of 0.92 km to the TTS criteria for the MODU. Note this distance is based on a SEL over 24 hours. 3 km is deemed an appropriate distance for resupply based on the modelled distance of 2.73 km to the TTS criteria for resupply activities. Note this distance is based on a SEL over 24 hours. 30 minutes is deemed appropriate to account for deep diving species such as blue whales.	
CM#6 Marine mammal observer		A dedicated person who has proven experience in whale observation, distance estimation and reporting will be on the MODU to: • identify whales and behaviours. • direct the vessel to maintain the defined separation distance. • undertake drilling and resupply prestart observations. Note: due to the height of the MODU the MMO can observe a greater distance than from a vessel and can provide direction to the OSV via radio. This is more efficient, provides a better platform for observations and allows for a more holistic oversight of whales at a greater distance. The vessel will still maintain watch for whales and provide any sighting information to the MMO on the MODU. The vessel may have to move to ensure that the MMO has a clear line of sight to any whales sighted from the vessel.	
Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Seasonal timing	Procedure	The Artisan-1 well is the first well to be drilled as part of a drilling campaign within Beach's Otway Development area which is located within the pygmy blue whale foraging BIA. The full drilling campaign will take up to 2 years. The MODU will be on hire to Beach	No

		for this period. Pygmy blue whales are potentially in the foraging BIA within the Otway shelf waters from January through to April (Gill et al., 2011). Southern right whales may also travel through the noise behaviour EMBA to coastal aggregation and migration areas be during May and June. If Beach was to avoid the period from January to June it would extend the drilling program leading to significant delays to the Otway Development and increased costs would make the project unviable. As the area of impact is small at a maximum of 2.1% of the pygmy blue whale high density foraging BIA and 0.35% of the southern right whale current core coastal range during resupply operations which is for a number of hours and 0.57% of the pygmy blue whale high density foraging BIA and 0.092% of the southern right whale current core coastal range during normal operations of drilling with the vessel on standby. No impacts were predicted to southern right whale established and emerging aggregation BIAs and migration and resting on migration BIA. Impacts can be managed to an acceptable level via the implementation of other controls.	
Anchoring of vessels	Equipment	Vessel noise could be minimised by the support vessels anchoring when on station near the MODU. This is not feasible as the MODU must be able to react to an errant vessel, man overboard or other safety issues. The vessels cannot anchor when unloading or loading the MODU as the vessel needs to be able to hold station relative to the MODU.	No
Shut down zones	Procedure	The MODU, support vessels and drilling activities cannot be shut down as this could introduce unacceptable safety and environment risks. *MODU:* Shutting down the MODU in the event that whales approach closer than 0.92 km (the distance that the TTS criteria is reached) could introduce additional safety and environmental hazards, including and not limited to: • impairment of safety and environmental critical equipment on the MODU; • dropped or swinging objects from crane or derrick resulting in potential MODU stability impairment; • stuck pipe downhole while drilling and risk of exposure to personnel due to stored energy attempting to free the drill string; • inability to maintain well integrity with possible loss of containment from the well. A number of significant events as outlined above may result, which can lead to consequences to the health and safety of personnel on the MODU or to spills to the environment. Potential also exists for escalation to other more serious outcome events and medical emergency involving the need to treat and evacuate	No

injured parties from the installation and implement oil spill response.

Furthermore, the ability to implement the process of safely shutting down MODU operations will vary depending on the well activities of the MODU at the time. This process can range from 4 hours to 2 days to ensure the well can be safely secured and well integrity established, such that the MODU can then be safely shut down to only critical systems. As a result, the use of shutdown zones for the MODU is not considered feasible or practicable.

As detailed in the assessment of pre-start observations below, it is unlikely that whales would come into the area where noise levels are above the PTS and TTS criteria once the MODU is on location. Pre-start up observations and delayed start where whales are within 1 km of the MODU, will ensure that pygmy blue whales can continue to utilise the foraging BIA without being injured or displaced as per the requirements of the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). It also ensures other whales such as fin, pygmy right, sei and southern right whales will not be injured or displace whales foraging or moving through the area.

Vessels:

Support vessels will use DP to maintain position when in the operating area so they can quickly respond to any safety issues on the MODU or to intercept vessels that maybe entering the MODU 500 m safety exclusion zone. The HSE Case Revision Beach Energy Otway Phase 4 Drilling and Completions Campaign (2020-21) details that support vessels are to be available for immediate use during the period that the support vessel is performing MODU safety standby services. Thus, anchoring is not a feasible option.

Shutting down the vessel propulsion system could introduce safety and potentially environmental risks with no increased environmental benefit. Shutting down the vessel propulsion system could lead to the vessel drifting and colliding with the MODU or another vessel potentially resulting a safety risk to personnel or an oil spill. It could also result in a vessel strike to the whales that shutting down the propulsion system is meant to protect.

As detailed in CM#4, the support vessel will maintain a safe operating distance to whales of 1.2 km, which is greater than the TTS (1.12 km) criteria for low-frequency cetaceans. The implantation of a 1.2 km safe operating distance will ensure that pygmy blue whales can continue to utilise the foraging BIA without being injured or displaced as per the requirements of the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). It also ensures other whales such as fin, pygmy right, sei and southern

		right, will not be injured or displaced while foraging or moving through the area.	
Pre-start observations	Procedure	It is unlikely that these whales would come into the area where noise levels are above the PTS and TTS criteria once the MODU and vessel are on location. However, they may be disturbed if they are already foraging or present in the area. Thus, observations by a person who has proven experience in whale observation, distance estimation and reporting will be undertaken prior to the commencement of drilling and any resupply activities. This additional control ensures that pygmy blue whales can continue to utilise the foraging BIA without being injured or displaced. It also ensures other whales such as fin, pygmy right, sei and southern right whales will not be injured or displace whale foraging or moving through the area. Thus, the environmental benefits outweigh the costs.	Yes
Whale aerial surveillance	Procedure	Aerial surveys are sometimes undertaken in areas where whales may be present in large numbers or undertaking biologically important behaviours. These are typically undertaken for seismic surveys that cover large areas per day to allow them to avoid areas where whales may be present. The MODU will be stationary on the well location and the support vessel within or just outside the operational are (2 km). Thus, the activity does not cover large areas on a day by day basis. Positioning the MMO on the MODU which is further out of the water than a vessel will allow for observations to be undertaken at a greater distance to identify whales and any behaviours such as foraging.	No

Consequence rating	Moderate (2)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Noise emissions were assessed as having a moderate (2) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding noise emissions.
Other requirements	Noise emissions will be managed in accordance with legislative requirements. Noise emissions will: • not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area (Commonwealth of Australia, 2015b).

	• not impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • not impact southern right whale established or emerging aggregation BIAs or the migration and resting on migration BIA (Commonwealth of Australia 2015b). • not impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC, 2013a). Actions from the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • assessing the effect of anthropogenic noise on blue whale behaviour. Section 7.4 assesses the effects of anthropogenic noise from the activity on blue whale behaviour. • anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. Section 7.4 demonstrates that the activity can be conducted in a manner that is consistent with the conservation management plan and will not result in injury or displacement of pygmy blue whales from a foraging BIA.
Monitoring and reporting	Impacts associated with noise emissions are for a short duration, over small area and not predicted to have long term impacts to fauna in the area. Therefore, the monitoring of noise emissions is not proposed. Any whale sightings will be recorded using the DAWE sighting sheets as detailed in Section 8.10.2.
Acceptability outcome	**Acceptable**

7.5 Physical presence

7.5.1 Hazards

In anticipation of drilling a 500 m petroleum safety zone (PSZ) is in place for the Artisan-1 well location and eight anchors have been prelaid within at a distance of ~ 1,300 m from the Artisan-1 well.

The Artisan-1 well may be suspended for future production if the well intersects a commercial hydrocarbon column. In the event of the well being suspended, the wellhead will remain in place and may be used to facilitate future production well operations. Thus, the PSZ will remain in place permanently if the well is to be developed or until it is plugged and abandoned.

The anchors will remain in place until drilling is complete. The surface buoys associated with the anchors will be in place until the MODU is anchored on location to drill the well. The surface buoys have a navigation light.

7.5.2 Known and potential environmental impacts

The physical presence of the PSZ and anchor surface buoys can result in the displacement of other marine users such as:

- recreation and tourism
- commercial shipping
- petroleum activities
- commercial fishing

The physical presence of the anchors and suspended wellhead on the seabed can result in snagging of fishing equipment

7.5.3 Consequence evaluation

Recreation and tourism

Due to the distance that the activity is offshore (32 km) and no emergent features within the operational area recreational fishing and tourism is unlikely.

Commercial shipping

The operational area includes major shipping routes (Section 5.8.4) however, vessels and MODU activities associated with the Otway Gas Development have been ongoing for over 10 years and to date there has been no interactions or incidents.

Vessels would be required to avoid the surface buoys as per any other navigational hazard. The location of the anchors and associated buoys have been communicated to mariners via an AUSCOAST warning.

Prior to drilling commercial vessels would be required to deviate 2 km around the area of the anchors which is normal practice in a busy shipping area close to major ports as Geelong and Melbourne. As the area has been communicated to mariners via an AUSCOAST warning, vessels are able to plan their journey to avoid the area.

Prior to drilling the extent of the area of impact is predicted to be 2 km for 18 months. The severity is assessed as minor based on the area of impact is small, has been communicated and is part of normal navigational requirements for safe operation of commercial vessels.

Once the MODU is on location and anchored commercial vessels would be required to deviate 500 m around the MODU. As the MODU being on location and the implementation of the PSZ is communicated to marine users, commercial vessels would be able to plan their journey to ensure they are not inconvenienced by the 500 m exclusion area.

Once the MODU is anchored the extent of the area of impact is predicted to be 500 m from the MODU for 55 days and then permanently if the well is suspended. The severity is assessed as minor based on the area of impact is small and the exclusion is required for safe operations of the MODU and commercial vessels.

Petroleum activities

No petroleum activities have been identified within the operational area in the period that the anchors would be insitu or drilling would occur. Therefore, displacement impacts to other petroleum activities is not predicted.

Commercial fishing

AFMA detailed that there are currently no active vessels in Commonwealth fisheries within the operational area (Stakeholder Record AFMA 02). SETFIA have confirmed there is no trawl or gill net fishing in the operational area (Stakeholder Record SETFIA 87). No Tasmanian State-managed fisheries overlap the operational area.

The Rock Lobster Fishery is the only Victorian State-managed fishery that has catch effort within the fishing grid that overlaps the operational area. Based on Victorian Fishing Association data from 2014 to 2018 the Rock Lobster Fishery has catch effort in fishing grid J12 where the operational area is located. Fishing effort within the J12 grid is low with a maximum of one fisher in the months (10 months) that there was fishing during the period of 2014 – 2018. Data from the Fugro (2019) Artisan-1 seabed survey did not identify any rocky reefs or outcrops that would be rock lobster habitats.

During stakeholder consultation, up to six fishers have identified they may fish in the broader Otway Offshore Project area which includes the Artisan operational area (Section 9).

Via stakeholder engagement SETFIA raised concerns in relation to snagging of fishing equipment. This promoted Beach to engage SETFIA to determine what fisheries fished in the area and the methods used. The SETFIA report (Stakeholder Record SETFIA, SSIA, SPF 48) on Trawl and Gillnet fishing activity (October 2019) found:

- Trawl fishing in the Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector board trawl sub-sector does not occur in the Otway Offshore Project area as the grounds appear too rough for trawl fishing in its current form.
- Gillnet fishing in the Southern and Eastern Scalefish and Shark Fishery Gillnet Hook and Trap Sector does not seem to occur within the Otway Offshore Project area.
- There is no Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Danish seine sub-sector fishing in the Otway Offshore Project area.

There is a clear separation of these commercial fishers and the Offshore Project area which the Artisan-1 well location is within. Therefore, no interaction is anticipated between trawl or gill net fishers during drilling, while the anchor are insitu and if the Artisan-1 well is suspended.

Stakeholders have raised concerns in relation to displacement of their fishing activities. The extent of displacement and where the prelaid anchors are is the operational area (2 km radius) for a duration of up to 18 months. The severity is assessed as minor based on:

- small area of displacement (12.6 km^2) for a period of up to 18 months.
- small area of displacement (0.79 km^2) if the well is suspended and the PSZ remains in place.

- no trawl or gill net fishing occurs in the operational area.
- no habitat that would support rock lobsters have been identified in the operational area.
- limited fishing has been identified within the operational area

Via stakeholder engagement it has been agreed that any displacement impacts can be managed based on:

- area of impact communicated to mariners via an AUSCOAST warning allowing vessels and fishers to avoid the area where the anchors are located.
- look-ahead information will be provided to fishers allowing them to plan their fishing activity to avoid when the MODU will be at a well location.
- operating protocol developed and provided to those fishers that potentially fish at the well locations to minimise impacts to fishers.
- Beach has detailed in its Commercial Fisher Operating Protocol provided to potentially impacted fishers that fishers should not suffer an economic loss as a result of Beach's activities. Should a fisher incur additional costs in order to work around Beach's activities, or if they have lost catch or have damaged equipment Beach will assess the claim and ask for evidence including past fishing history and the loss incurred and, where the claim is genuine, will provide compensation. Beach will also ensure that the evidence required is not burdensome on the fisher while ensuring genuine claims are processed.

7.5.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Air emissions	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from physical displacement are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. Though objections and claims have been raised by stakeholders in relation to trawl and gillnet snagging risks on subsea wells subsequent data identified that there is no trawl or gillnet fishing in the operational area. Objections and claims have been raised by stakeholders in relation to displacement of their fishing areas, however, these have been adequately assessed and controls adopted to manage impacts to ALARP. As the impact consequence is rated as minor (1) applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#7: Ongoing consultation	Consultation will continue with relevant stakeholders as detailed in Section 9.7
CM#8: Petroleum Safety Zone (PSZ)	PSZs, administrated by NOPSEMA under the OPGGS Act, are specified areas surrounding petroleum wells, structures or equipment which vessels or classes of vessel are prohibited from entering or being

	present in. Applicants of a PSZ must demonstrate effective consultation with parties which may be directly impacted	
CM#9: Commercial Fisher Operating Protocol	Beach's Commercial Fisher Operating Protocol (Appendix D) was developed and provided to fishers who have identified that they may be potentially impacted. The protocol details pre-activity and on-water communication processes, including SMS messages and radio communication on Channel 16, data confidentiality and Beach's claim process. The protocol was developed based on feedback from consultation with the fishers who have identified they could be potentially impacted.	
CM#10: Navigation aids	Anchors equipped with a surface buoy with a navigation light to ensure any marine users know of their presence.	
CM#11: AUSCOAST warning	AUSCOAST warning issued by AMSA for anchors equipped with a surface buoy to warn other marine users of the location of the anchors and buoys.	
CM#12: Anchor buoy monitoring	The position of the anchor buoys will be monitored to ensure that the buoys and anchor chains remain as per the Mooring Plan. Each anchor buoy has a device tracking and control (DTAC) transmitter which transmits the buoy position every 12 hours. A geofence has been set at 100 m around each buoy which will notify the monitoring company if the buoy has moved. A helicopter or vessel will transit to site within 48 to initially inspect the buoys if: • DTAC readings are not functional. • Buoys are outside of the 100 m geofenced area for three consecutive DTAC readings. To remediate or recover buoys will require a suitable vessel, such as an anchor handler, able to be mobilised within 5 days of initial notification (or within 24 hours if already crewed and operational). If a buoy has parted from the anchor chain, attempts will be made to recover it. If the buoy is not recoverable it will be reported to If the buoy is not recoverable it will be reported to AMSA who will issue a Notice to Mariners. Three consecutive readings is deemed appropriate to initiate a visual inspection of the buoys as it allows confirmation that the readings are not anomalies. As a suitable vessel to remediate or recover the buoy may take up to 5 days to man and mobilise Beach has put in place the additional control of mobilising a smaller vessel or helicopter to conduct a visual inspection to confirm the status of the buoys.	
CM#13: Anchor buoy inspection	A visual inspection of the anchor buoys will be undertaken at least 6-monthly to ensure they are maintained. Six monthly inspections are a typical timeframe for offshore buoys.	
Additional controls assessed		
Control	**Cost/Benefit Analysis**	**Control Implemented?**

Remove anchors and re-lay closer to the time of drilling.	Removal and re-lay of anchors will take up to 10 days with an estimated cost of $500K plus storage of $150K. Removal and re-lay would increase (up to double) the disturbance of the seabed. It would also increase vessel activity associated impacts and risks based on an additional 10 days of vessel activity. Other than shipping activities no recreational and limited commercial fishing activities have been identified to occur within the area where the anchors are located. A four week pre-drilling notifications was provided to marine users when the drilling was previously going to occur including if stakeholders wanted information on the rig and vessel locations and updates. No response was obtained further supporting that the area has a low marine user use. Based on the low level of marine users that utilise the area the risk of impact to marine users is extremely low, there is more benefit leaving the anchors insitu such as no further seabed disturbance, no increase in vessel activity and additional cost to Beach.	No

Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Physical displacement does not have the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	The merits of claims or objections raised by a relevant stakeholder have been adequately assessed and additional controls adopted where appropriate.
Other requirements	Physical displacement and snagging will be managed in accordance with the applicable legislative requirements and the Beach Commercial Fisher Operating Protocol.
Monitoring and reporting	Monitoring of potential impacts is undertaken via stakeholder engagement and reporting of any incidents. Monitoring of the anchors and buoys is undertaken as per control measures CM#11, !2
Acceptability outcome	**Acceptable**

7.6 Benthic disturbance

7.6.1 Hazards

Benthic disturbance can occur where there is interaction with the seabed from anchors, transponders and parking or storing equipment on the seabed.

7.6.2 Known and potential environmental impacts

Benthic disturbance can impact on benthic habitats and fauna through smothering and alteration of habitat and localised and temporary increases in suspended sediments near the seabed.

7.6.3 Consequence evaluation

The extent of the benthic disturbance is estimated to be approximately 0.788 km^2 within the 2 km operational area as detailed in Table 7-8. For this assessment an area of 0.8 km^2 is used to provide a more conservative estimate of the area of impact.

Table 7-8: Activities that will result in benthic habitat disturbance

Activity	Description	Area of impact (m^2)	Area of impact (km^2)
Anchoring	8 anchors and chain have been prelaid with an estimated footprint of 326 m^2 per anchor.	2,608	0.0026
Drill cuttings and cement discharges	Drill cuttings and cement discharges may be present up to 500 m from the well site (See Section 7.9 and 7.10).	785,398	0.785
RoV operations	The RoV may be temporarily parked on the seabed. This would cover an area of 2 m^2. This would be within the area drill cuttings and cement discharges may potential impact the seabed (500 m from the well site).	NA	NA
Wellhead	Installation and removal of the wellhead if the well if not suspended: This would be within the area drill cuttings and cement discharges may potential impact the seabed (500 m from the well site).	NA	NA
Total		788,006	0.788

As detailed in 5.6.2, during October 2019 a seabed survey was undertaken over a 5.0 km by 4.6 km area around the proposed Artisan-1 well location (Fugro, 2019). The survey identified:

- the seabed topography is dominated by exposed rock on the seabed.
- small patches of very thin transgressive coarse sand are present across the survey area.
- the seabed showed a scattered sessile biota on a sandy seafloor.
- no rocky reefs or outcrops were identified.

The operational area overlaps the Shelf Rocky Reefs and Hard Substrates KEF. No threatened ecological communities or habitats critical to the survival of the species were identified within the operational area. The rocky reefs and hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF, are located in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break (Commonwealth of Australia, 2015c). This KEF has not yet been spatially defined (DoE, 2015a).

The seabed survey for the Artisan-1 well (Fugro, 2019) identified hard substrate within the operational area but did not identify rocky reefs. The hard substrate included biota of macroalgae and sessile invertebrates which is characteristic of the hard grounds associated with the hard substrates' component of the Shelf Rocky Reefs and Hard Substrates KEF (Section 5.6.2). However, the hard substrate and associated biota characteristic of the hard substrate component of the Shelf Rocky Reefs and Hard Substrates KEF is not unique to the operational area based on Commonwealth of Australia (2015c) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait, and on surveys within the Otway Basin, as detailed below, that identified hard substrate with similar biota to that in the operational area.

A comprehensive assessment of the Otway Basin coast to continental shelf margin collecting bathymetric data and video footage for the pipeline right-of-way options was undertaken for the Otway Gas Project EIS (Woodside, 2003) (Section 5.6.1, Figure 5-10) identified:

- 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).

- benthic assemblages (CEE Consultants Pty Ltd, 2003) ranged from very low density sessile; large sponge to diverse, high density sessile: sponge, coral dominated crinoids common and mobile species.

- BBG (2003) found that the substrate in water depths that predominate in the Otway Gas Project operational area (between 82 and 66 m) area was predominantly low profile limestone with an incomplete sand veneer that supported a low to medium density, sponge dominated filter feeding community. Fish and other motile organisms were uncommon.

NERA (2018) detailed that during anchoring activities, there is also potential for soft sediments to be suspended into the water column, which has the potential to affect benthic communities through a decrease in water quality or light penetration near the seabed. NERA (2018) surmised that given the hydrodynamics in open ocean areas, the area of decreased water quality is expected to be localised and temporary, as sediments would settle out of the water column relatively quickly. The seabed in the operational area consists of a sandy floor within an open ocean area thus impacts in relation to suspended sediments from benthic disturbance would be on a similar localised temporary scale or less as identified by NERA (2018).

There is limited information on the recovery of benthic habitats after the removal of anchors and other equipment. As the affected areas are expected to be like the surrounding seabed it would be expected that following removal of the anchors and other equipment sand and other material would begin to fill the area of disturbance and that recolonization would occur. This could take months to a year or more but is unlikely to have lasting effects.

The extent of the area of impact is predicted to be 0.8 km^2 for a duration of up to months to years while the disturbed area recolonises. The severity is assessed as minor based on:

- the area of impact is very small at 0.8 km^2.

- no threatened ecological communities, critical habitats, sensitive or protected benthic habitat or species, including commercial invertebrate species, have been identified in the area of impact (operational area).
- though the operational area overlaps hard substrate similar to that described for the Shelf Rocky Reefs and Hard Substrates KEF this feature, and associated biota are not unique to the operational area based on Commonwealth of Australia (2015c) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait, and on surveys within the Otway Basin that identified hard substrate with similar biota to that in the operational area.
- due to the small area of disturbance and that the hard substrate habitat and associated biota is not unique to the operational area the benthic disturbance will not modify, destroy, fragment, isolate or disturb a substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results.
- Hosack and Dambacher (2012) detail that oil and gas development was not proposed to have direct impacts on the functional groups of the Shelf Rocky Reefs and Hard Substrates KEF because of the oil and gas development small spatial footprint.
- there is no impediment to the disturbed areas recolonising as the benthic habitat and associated biota is not unique within the operational area.

7.6.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Benthic disturbance	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from benthic disturbance are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to benthic disturbance. As the impact consequence is rated as minor (1) applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#14: Site survey	A site survey has been undertaken of operational area to identify rocky reefs or outcrops that ae typically of high biodiversity value and habitat for rock lobsters. No rocky reefs or outcrops were identified,
CM#15: API RP 2SK – mooring analysis	The mooring analysis is undertaken to ensure the anchor pattern is appropriate for the environmnet. It ensures there is not slippage of the anchors which can result in increased benthic disturbance.
CM#16: ISO 19901-7:2013 – mooring tensioning	Anchor slippage and lack of tensioning on the anchor chains can result in increased benthic disturbance.
CM#17: Mooring plan	The mooring plan will ensure that the anchors are within the 2 km operational area.
CM#18: OPGGS Act	Section 572 of the OPGGS Act details the requirements for removal of property.
Consequence rating	Minor (1)

Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Benthic disturbance was assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding benthic disturbance.
Other requirements	Due to the small area of disturbance (maximum of 0.8 km^2) and that the hard substrate habitat and associated biota is not unique to the operational area the benthic disturbance will not modify, destroy, fragment, isolate or disturb a substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results.
Monitoring and reporting	Impacts associated with benthic disturbance are over a small area and not predicted to have long term impacts. Therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

7.7 Planned marine discharges – waste waters and putrescible waste

7.7.1 Hazards

The vessels and MODU have planned marine discharges within the operational area (2 km from the Artisan-1 well) such as cooling water, brine, bilge water, deck drainage, putrescible waste, sewage and grey water.

Quantities of planned discharges within the operational area per day are provided in Section 4.5.3.1.

7.7.2 Known and potential environmental impacts

Planned marine discharges can result in changes in water quality such as increased temperature, salinity, nutrients, chemicals and hydrocarbons which can lead to toxic effects to marine fauna.

Putrescible waste discharges can result in changes in fauna behaviour if result in fauna habituate to this food source.

Based on a review of all waste water discharges the

7.7.3 Consequence evaluation

7.7.3.1 Planned marine discharges

The consequence evaluation considers the potential cumulative impacts from:

- planned marine discharges of waste waters and putrescible wastes from the MODU and a support vessel when undertaking petroleum activities within the operational area.
- planned marine discharges of waste waters such as cement, BOP hydraulic fluid, suspension fluids and cuttings from the MODU.

These discharges are summarised in Table 7-10 and in summary:

- nutrients levels may be intermittently elevated within 500 m of the MODU and of the support vessel when sewage, greywater and putrescible waste discharged.
- water temperature may be elevated within 100 m of the of the MODU and of the support vessel from the constant discharge of cooling water.
- hydrocarbon levels may be intermittently elevated within 100 m of the support vessel when bilge waster is discharged and 100 m of the MODU when bilge water or cuttings with SBDFs are discharged.
- turbidity levels may be intermittently elevated up to 150 m form the MODU from the discharge of cuttings and cement.
- chemical additives that maybe within discharges may impact water quality within 4 m of the support vessel and 100 m of the MODU intermittently during drilling and within 500 m once during wellhead removal.

Cumulative impacts may occur from the discharge area of the MODU and support vessel overlapping. This will only occur when the support vessel is within 500 m of the MODU when unloading which occurs for a short period of time. The small additional volumes that the support vessel will discharge and intermittent nature of the discharges, except for cooling water which has a predicted area of impact of 100 m, would be unlikely to significantly increase the impact extent beyond 500 m or the impacts to water quality and marine receptors while unloading is occurring.

Cumulative impacts to water quality may also occur from the discharge of the same impact parameter from the different MODU or support vessel discharges. From Table 7-10 this may occur at a maximum distance of 100 m of the MODU and was not identified for the support vessel based on:

- turbidity from the discharge of drill cuttings and cement from the MODU. However, as cementing operations occur between drilling the well sections there is no period of overlap with these discharges.
- hydrocarbons from the discharge of SBDF cuttings and bilge water from the MODU. These discharges may overlap and may lead to an increase in hydrocarbon levels within 100 m (predicted impact distance for bilge water and for drill cuttings) from the MODU.
- chemicals in MODU brine discharges (4 m predicted impact), drilling cuttings (100 m predicted impact), BOP testing and latching and unlatching (500 m predicted impact and suspension fluids (500 m predicted impact). Well suspension, which is a one-off discharge, will occur after drilling has ceased so there is no overlap with these discharges. BOP testing and latching and unlatching does not occur while drilling is being undertaken. Brine discharge containing small quantities of scale inhibitor and biocides may occur when cuttings are discharged, or when BOP fluids are discharged or when suspension fluids are discharged resulting in a decrease in water quality within 4 m of the MODU.
- none of the support vessels discharges have the same impact parameter.

Based on the review of the waste water discharges in Table 7-10 and summarised above, it is predicted that water quality may be affected to a maximum of 500 m of the MODU and 500 m of the support vessel. Cumulative impacts from the MODU and support vessel may occur within 500 m of the MODU. Cumulative impacts from vessel discharges were not identified and may occur within 100 m for the MODU.

For the consequence evaluation 2.5 km from the Artsian-1 well will be used as this takes into account that the support vessel could be at the outer boundary of the 2 km operational area. A distance of 2.5 km also provides a conservation distance in relation to any cumulative impacts as detailed above. This is called the waste water discharge EMBA and has an area of 19.63 km^2.

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that are ecologically significant. Subsequently, there is expected to be limited impact on aggregations of marine life feeding on plankton.

Fish species, including commercial species maybe present within the waste water discharge EMBA. There are no BIAs or protected habitats and commercial fishing for fish species has not been identified within the waste water discharge EMBA. No features have been identified where site attached species would be present. As fish species would be transient in the waste water discharge EMBA toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The waste water discharge EMBA overlaps the distribution BIA for white shark by 0.01% (19.63 km^2/215,260 km^2), although no critical habitats or behaviours are known to occur. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify vessel or MODU discharges or equivalent as a threat. As these species would be transient in the waste water discharge EMBA toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the waste water discharge EMBA though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) though not specifically from vessels or MODUs and is focus on long term exposure. As these species would be transient in the waste water discharge EMBA toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The waste water discharge EMBA area overlaps the pygmy blue whale foraging BIA by 0.06% (19.63 km^2/35,627 km^2). The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) does not identify discharges from vessels or MODUs as a threat to the recovery of these species. It does identify that marine pollution can have a variety of possible consequences for blue whales at an individual and population level, or indirectly through harming their prey or the ecosystem. The conservation plan identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that chemicals associated with a spill is classed as a minor consequence impacts from low toxicity discharges that would rapidly dilute would be expected to be the same or a lower consequence,

The waste water discharge EMBA area overlaps the southern right whale current core coastal range by 0.01% (19.63 km^2/217,825 km^2). The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify discharges from vessels or MODUs as a threat to the recovery of these species but does identify chemical pollution in the form of sewage and industrial discharges as a threat more likely in coastal aggregation areas. The conservation plan identifies acute chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that the conservation plan identifies acute chemical discharge as a threat more likely in coastal aggregation areas it would be expected that chemical discharges in an offshore area which would rapidly dilute would be the same or lower consequence,

The South-east Marine Region Profile (Commonwealth of Australia, 2015c) details that the oceanography of the South-east Marine Region contributes to enhanced areas of primary productivity, including:

- spring and autumn phytoplankton blooms in the Subtropical Convergence Zone (south of Tasmania).
- primary productivity associated with the Bass Cascade and upwelling of cool nutrient-rich waters along the mainland coast north-east of Bass Strait.
- localised seasonal upwellings along the Bonney Coast.

The closest of these high productivity areas to the Artisan-1 well is the Bonney coast upwelling KEF. Figure 5-9 shows that the Artisan-1 well is ~83 km from the Bonney Coast Upwelling KEF, therefore the waste water discharge EMBA is 80.5 km (83 km less 2.5 km). The Bonney Coast Upwelling KEF is an area of high productivity and aggregations of marine life, of importance as feeding grounds to blue, sei and fin whales and higher predatory species, typically in summer and autumn months when drilling activities have been scheduled. However, based on the large distance between the waste water discharge EMBA and the Bonney coast upwelling KEF impacts to water quality and therefore productivity are not predicted.

The extent of impact, including any cumulative impacts, is predicted to be 500 m from the MODU or vessel with a maximum distance of 2.5 km from the Artisan-1 well which equates to an area of impact of 19.63 km^2 for a duration of up to 55 days while drilling is undertaken. The severity is assessed as minor based on:

- marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- marine discharges are not predicted to have lasting effects on either the biological or physical environment in the area of open water up to 2.5 km from the Artisan-1 well with no specific value when compared with surrounding waters.
- the waste water discharge EMBA overlap with the white shark distribution BIA is 0.01% and the Recovery Plan for the White Shark (DSEWPaC, 2013a) does not identify vessel or MODU discharges or equivalent as a threat.

- the waste water discharge EMBA overlap with the pygmy blue whale foraging BIA is 0.06% and the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- the waste water discharge EMBA overlap with the southern right whale current core coastal range is 0.01% and the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies acute chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- as the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.
- given the anticipated rapid dilution of low concentration of hydrocarbons and chemicals within the water column, there is no identified potential for decreases in water quality that may impact on marine fauna attracted to regional upwelling events.

7.7.3.2 Putrescible waste

The operational area where the support vessel and MODU would discharge putrescible waste overlaps foraging BIAs for several albatross species (Figure 7-4 to Figure 7-10), common diving-petrel (Figure 7-11) and wedged-tailed shearwater (Figure 7-13). The short-tailed shearwater foraging BIA is 11 km form the operation area (Figure 7-12). No habitat critical to the survival of seabirds occur within the operational area. Marine pollution is identified as a threat in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a); however, MODU and vessel food waste discharge would be sporadic and for a short duration thus would not result in seabirds habituating to this food source. The common diving-petrel (listed as marine) and wedged-tailed shearwater (listed as marine and migratory) do not have a recovery plan or conservation advice.

Fish may also become attracted to the food waste but as for seabirds the sporadic nature of MODU and vessel food waste discharge would not lead to fish habituating to this food source.

Periodic discharge of macerated food waste (up to 310 kg per day from the MODU and support vessel) to the marine environment will result in a temporary increase in nutrients in the water column that is expected to be localised to waters surrounding the discharge with no lasting effects to either the biological or physical environment. Therefore, the consequence has been evaluated as **Minor (1)**.

The extent of the impact is predicted to be 500 m from the MODU and support vessel with a duration of up to 55 days. The severity is assessed as minor based on:

- food waste discharges are sporadic and for a short duration thus would not result in fauna habituating to this food source.
- food waste will rapidly disperse in the marine environment.
- The nutrients within putrescible waste are to be discharged within an area of regionally elevated nutrient levels created by seasonal upwelling events, therefore additional nutrients loading is not likely detrimental to marine fauna.

Table 7-9: Cumulative discharges from MODU and a single support vessel within the operational area

Discharge type	Predicted volume	Predicted concentration	Impact parameter	Predicted cumulative extent of impact	Extent	Impact duration
Putrescible waste	310 kg / day	N/A	Nutrient levels	A review of sewage, putrescible wastes and grey water discharges to determine the extent of potential impact for the NERA (2019) Environment Plan Reference Case for Planned Discharge of Sewage, Putrescible Waste and Grey Water determined that sewage and greywater discharge volume up to 150 m^3/day is expected to remain within the nominal mixing zone boundary of 500 m around fixed facilities. Discharged wastewaters will be dispersed by wind-driven surface water currents plus wave action and rapidly mixed through the surface layer of water. Previous monitoring of wastewater discharges has demonstrated that a 10 m^3 sewage discharge over 24 hrs from a stationary source in shallow water, reduced to approximately 1% of its original concentration within 50 m of the discharge location (Woodside 2008). Therefore, there is potential for a temporary minor increase in nutrient levels up to 500 m from the MODU or support vessels.	500 m	Intermittent discharge for up to 55 days
Sewage and grey water	70 m^3 / day	N/A				
Cooling water	4,800 m^3 / day	N/A	Temperature (°C)	Cooling water is used on the MODU and support vessels to cool engines. Seawater is extracted through intakes and circulated through heat exchanges and then discharged back to the sea. Modelling of continuous wastewater discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program predicted that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being < than 1°C above ambient within 100 m (horizontally) of the discharge point, and 10 m vertically (Woodside 2014). The Torosa South-1 well was in ~ 44 m water depth within a coral reef and hence cooling water	100 m	Constant for up to 55 days

Discharge type	Predicted volume	Predicted concentration	Impact parameter	Predicted cumulative extent of impact	Extent	Impact duration
				discharges from a vessel or MODU the within the operational area, where ocean currents range from 0.2 m/s to 2.0 m/s, are likely to decrease in temperature in a shorter distance. Therefore, there is potential for a temporary minor increase in in water temperature up to 100 m from the MODU or support vessels.		
Bilge water	Limited to holding capacity of bilge – either MODU or vessel	Treated to 15 ppm	Total Petroleum Hydrocarbons (TPH)	Treated bilge discharge is infrequent, being driven by the holding capacity of the bilge space onboard the vessel or MODU. In the absence of published literature on the potential extent of impact as a result of bilge discharges for drilling activities, treated bilge and drainage discharge plumes modelled for Prelude FLNG is used as a conservative estimate for this assessment. Modelling by Shell (2009) indicates that hydrocarbon and other chemical concentrations are rapidly diluted and expected to be below predicted no effect concentration within less than 100 m of the discharge. Therefore, there is potential for a temporary minor decrease in water quality from bilge water discharge up to 100 m from the MODU or support vessels.	100 m	Infrequent for up to 55 days
Brine	168 m^3 / day	Typically, 20 % to 50 % higher in salinity than the intake seawater.	Salinity	Brine is a by-product of fresh water generation using reverse osmosis onboard the vessels and MODU. Brine discharges are typically 20 to 50 % higher in salinity than the intake seawater (depending on the desalination process used) and may contain low concentrations of scale inhibitors	4 m	Intermittent discharge for up to 55 days

Discharge type	Predicted volume	Predicted concentration	Impact parameter	Predicted cumulative extent of impact	Extent	Impact duration
		Low concentrations of scale inhibitors and biocides	Chemical additives	and biocides, which are used to avoid fouling of pipework (Woodside, 2014). Models developed by the US EPA for temporary brine discharges from vessels assuming no ocean current (i.e. 0 m/s) found that brine discharges from the surface dilute 40-fold at 4 m from the source (Woodside, 2014). Thus, brine discharges from a vessel or MODU within the operational area, where ocean currents range from 0.2 m/s to 2.0 m/s, are likely to dilute in a shorter distance. Therefore, there is potentially for slightly elevated salinity levels and a minor reduction in water quality within 4 m from the MODU or support vessels.		
Drilling cuttings	Seabed discharge: 135 m^3	Seawater and non-toxic gel sweeps	Turbidity	See Section 7.9 for details in relation to cuttings discharges. In summary: The drilling cuttings and fluid plume is predicted to dilute by more than 100-fold within 10 m of the discharge (Neff, 2005). Based upon dilutions identified by Hinwood et al. (1994) and Neff (2005), turbidity in the water column is expected to be reduced to below 10 mg/L (9 ppm) within 100 m of release.	100 m	Intermittent for up to 55 days
	Surface discharge: 114 m^3	Synthetic based drill fluids (SBDF)	Turbidity Hydrocarbons Chemical additives			
Cement discharges	14 - 36 m^3	Cement	Turbidity	See Section 7.10 for details in relation to cement discharges. In summary: The extent of the impact is predicted to be 150 m from the MODU with a duration of four hours after each discharge.	150 m	Intermittent for up to 55 days
Suspension fluids	< 500 L	Suspension fluid	Chemical additives	See Section 7.8 for details in relation to suspension fluid discharges. In summary: Suspension fluids will be discharged to the marine environment during wellhead removal. The extent within which the suspension fluids would disperse is estimated to be with 500 m of the MODU.	500 m	Once

Discharge type	Predicted volume	Predicted concentration	Impact parameter	Predicted cumulative extent of impact	Extent	Impact duration
BOP hydraulic fluids	~ 2,200 L of potable water with 1 – 3% water-soluble control fluid every 7 days Smaller volumes every 21 days and when latching and unlatching BOP	Water-soluble control fluid	Chemical additives	See Section 7.8 for details in relation to BOP hydraulic fluids discharges. In summary: BOP hydraulic fluids are water-based and readily biodegradable and estimated to disperse within 500 m of the MODU.	500 m	Intermittent for up to 55 days

7.7.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to planned marine discharges. As the impact consequence is rated as minor applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#19: Hazardous Material Risk Assessment Process	All chemicals that will be or have the potential to be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
CM#20: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*	This Act regulates Australian regulated vessels with respect to ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, putrescible waste, garbage, air pollution etc.
CM#3: Preventative Maintenance System	Equipment to treat marine discharges such as bilge water, slops from deck drainage, sewage and food waste are maintained as per manufacturer's instructions to ensure efficient operation.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding planned marine discharges.
Other requirements	Planned marine discharge will be managed in accordance with legislative requirements. Planned marine discharges will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a).

	• impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. Therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

7.8 Planned marine discharges – BOP hydraulic fluids and suspension fluids

7.8.1 Hazards

BOP hydraulic fluids are released during BOP function and pressure testing.

Suspension fluids will be discharged to the marine environment during wellhead removal. Fluids will likely contain chemicals such as biocides and control fluid.

Cumulative impacts regarding planned marine discharges are assessed in Section 7.7.

7.8.2 Known and potential environmental impacts

Planned discharges of BOP hydraulic fluids and suspension fluids can result in changes in water quality which can lead to toxic effects to marine fauna.

7.8.3 Consequence evaluation

Function tests are generally undertaken every 7 days and will release ~ 2,200 L of potable water with 1 – 3% water-soluble control fluid. Pressure tests are generally undertaken every 21-day and may release small volumes of water-soluble fluids. In addition to this, BOP fluids are released whenever the riser is unlatched resulting in an additional release of fluids to the environment.

Hydraulic control fluids are water-based and readily biodegradable. As open marine waters are typically influenced by regional wind and large-scale current patterns resulting in the rapid mixing of surface and near surface waters any discharges of hydraulic control fluids would disperse rapidly within a small area. The extent within which the BOP hydraulic fluids would disperse is estimated to be with 500 m of the MODU.

The volume of suspension fluids discharged will be small (<500 L). As open marine waters are typically influenced by regional wind and large-scale current patterns resulting in the rapid mixing of surface and near surface waters any discharges of hydraulic control fluids would disperse rapidly within a small area. The extent within which the suspension fluids would disperse is estimated to be with 500 m of the MODU.

Within the 500 m extent of potential impact potential receptors to change in water quality would be plankton, fish, turtles and marine mammals. As the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that area ecologically significant.

Fish species, including commercial species maybe present within the operational area. There are not BIAs or protected habitats and commercial fishing for fish species has not been identified within the operational area. No features have been identified where site attached species would be present. As fish species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area is within the distribution BIA for white shark, although no critical habitats or behaviours are known to occur. Sharks will be transient through the area thus impacts are not predicted. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify MODU discharges or equivalent as a threat. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the operational area though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) though not specifically from MODUs. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

Marine mammals can actively avoid plumes, limiting exposure. The operational area overlaps the pygmy blue whale foraging BIA. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) does not identify discharges from vessels or MODUs as a threat to the recovery of these species. It would be highly unlikely that pygmy blue whales would be foraging within 500 m of the MODU or vessel as there are no features where krill would be in abundance. As such these species are likely to be transient within the operational area thus toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the southern right whale current core coastal range. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify discharges from vessels or MODUs as a threat to the recovery of these species. These species are likely to be transient within the operational area thus toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The extent of the impact is predicted to be 500 m from the MODU with a duration of up to 55 days. The severity is assessed as **Minor (1)** based on:

- marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- no sensitive resident receptors or particular values were identified within the area that may be affected when compared with surrounding waters.
- marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- discharges will rapidly disperse in the marine environment.

7.8.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges BOP installation and testing	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the impact consequence is rated as minor (1) applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.As the risk is rated as low applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#19: Hazardous Material Risk Assessment Process	All chemicals that will be or have the potential to be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.

CM#21: Preventative Maintenance System – BOP testing	BOP routinely function and pressure tested in accordance with manufacturer's specifications and in alignment with Drilling Contractors preventative maintenance System.
CM#3: Preventative Maintenance System	Systems that generate or treat planned discharges will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding planned marine discharges.
Other requirements	Planned marine discharge will be managed in accordance with legislative requirements. Planned marine discharges will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. Therefore, the monitoring is not proposed.
Acceptability outcome	**Acceptable**

7.9 Planned marine discharge – drilling cuttings and fluids

7.9.1 Hazard

Drilling activities will result in planned discharges of drilling fluids and cuttings, which will be discharged to the marine environment at the surface or subsea.

- seabed discharge: approximately 135 m^3 cuttings are discharged on the seabed during the drilling of the top-hole section of the well, prior to the riser being installed. Sea water and non-toxic gel sweeps are used for drilling top-hole sections.

- surface discharge: approximately 114 m^3 cuttings with residual drilling fluids are discharged at surface from the drilling of lower-hole sections of the well (excluding potential side-track), following the installation of the riser and BOP. The riser enables drilling fluids and cuttings to be recirculated back to the MODU for treatment via the solids control equipment prior to discharge.

Drilling cuttings are discharged continuously whilst actively drilling well sections, which may occur for periods of around 24 hours at a time.

Whole SBDF are not routinely discharged during drilling activities, as these fluids are recycled and reconditioned aboard the MODU, returned to shore for reconditioning or used in future drilling activities.

Cumulative impacts regarding planned marine discharges are assessed in Section 7.7.

7.9.2 Known and potential environmental impacts

A planned discharge of drill cuttings and fluids has the potential to result in an impact to receptors in the water column and sediments from:

- change in water quality;

- change in sediment quality; and

- change in habitat.

As a result of a change in water and sediment quality and a change in habitat, further impacts may occur, which include injury/mortality to fauna.

7.9.3 Consequence evaluation

7.9.3.1 Change in water quality

Receptors potentially impacted by a change in water quality through increased turbidity, chemical toxicity and oxygen depletion include:

- pelagic marine fauna

- plankton

- marine invertebrates

- benthic habitat (soft sediment, macroalgae, soft corals)

Hinwood et al. (1994) indicates that larger particles of cuttings and adhered muds (90-95%) fall to the seabed within close proximity of the release point. When cuttings are discharged to the ocean, the larger particles, representing about 90% of the mass of the mud solids, form a plume that settles quickly to the bottom (or until the plume entrains enough seawater to reach neutral buoyancy). About 10% of the mass of the mud solids form another plume in the upper water column that drifts with prevailing currents away from the platform and is diluted rapidly in the receiving waters (Neff, 2005; 2010).

Neff (2005) states that in well-mixed oceans waters (as is the case within the operational area), the drilling cuttings and fluid plume is diluted by more than 100-fold within 10 m of the discharge. Because of the rapid dilution of the drilling mud and cuttings plume in the water column, "harm to communities of water column plants and animals is unlikely and has never been demonstrated" (Neff, 2005).

Drilling of the Artisan-1 well will require the use of both WBDF and SBDF. Due to the inert / PLONOR nature of its components, WBDF have been shown to have little or no toxicity to marine organisms (Jones et al., 1996). Barite (a major insoluble component of water-based mud discharges) has been widely shown to accumulate in sediments following drilling (reviewed by Hartley 1996). Barium sulphate is of low bioavailability and toxicity to benthic organisms. Other metals present mainly as salts, in drilling wastes may originate from formation cuttings, or from impurities in barite and other mud components, however, do not contribute to mud toxicity due to their low bioavailability (Schaanning et al., 2002).

The American Chemistry Council (2006) found that because SBDF adhered to cuttings tends to clump together in particles that rapidly settle to the ocean floor, this suggests that SBDF-coated cuttings tend to be less likely to increase water column turbidity.

Neff (2010) explains that the lack of toxicity and low bioaccumulation potential of the drilling fluids means that the effects of the discharges are highly localised and are not expected to spread through the food web.

The extent of the impact to water quality is predicted to be < 100 m from the MODU with a duration of up to 55 days. The severity is assessed as moderate based on:

- the drilling cuttings and fluid plume is predicted to dilute by more than 100-fold within 10 m of the discharge (Neff, 2005).
- WBDF have been shown to have little or no toxicity to marine organisms (Jones et al., 1996).
- as SBDF tend to clump together and settle rapidly they are less likely to increase water column turbidity (American Chemistry Council, 2006).
- harm to communities of water column plants and animals is unlikely (Neff, 2005).

Benthic invertebrates and plankton

Jenkins and McKinnon (2006) reported that levels of suspended sediments greater than 500 mg/L are likely to produce a measurable impact upon larvae of most fish species, and that levels of 100 mg/L will affect the larvae of some species if exposed for periods greater than 96 hours. Jenkins and McKinnon (2006) also indicated that levels of 100 mg/L may affect the larvae of several marine invertebrate species, and that fish eggs and larvae are more vulnerable to suspended sediments than older life stages. Though, any impact to fish larvae is also expected to be limited due to high natural mortality rates (McGurk, 1986), intermittent exposure, and the dispersive characteristics of the open water in the operational area.

As detailed in Section 5.5.13.1, the Artisan-1 well is located ~83 km from the Bonney coast upwelling KEF – an area of high productivity and aggregations of marine life, of particular importance as feeding grounds to blue, sei and fin whales and higher predatory species, typically in summer and autumn months when drilling activities have been scheduled. The operational areas 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 see Section 5.6.8 Bonney coast upwelling).

Based upon dilutions identified by Hinwood et al. (1994) and Neff (2005), turbidity in the water column is expected to be reduced to below 10 mg/L (9 ppm) within 100 m of release. Therefore, as previous dilution estimates (e.g. Hinwood et al., 1994; Neff, 2005) suggest suspended sediment concentrations caused by the discharge of drill cuttings will be well below the levels required to cause an effect on fish or invertebrate larvae (i.e. predicted levels are well below a 96-hr exposure at 100 mg/L, or instantaneous 500 mg/L exposure), minimal impact to larvae is expected from the discharge of drill cuttings.

Plankton have a patchy distribution linked to localised and seasonal productivity that produces sporadic bursts in populations (DEWHA, 2008b). Plankton distribution 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. A change in water quality as a result of drill cuttings and fluids is unlikely to lead to injury or mortality of plankton at a measurable level and will not result in a change in the viability of the population or ecosystem dynamics during regional upwelling events or otherwise. Therefore, no impacts to plankton from drill cuttings or fluids discharges are predicted.

Marine fauna

The operational area is within a pygmy blue whale foraging BIA, southern right whale current core coastal range, and seabird foraging BIAs. However, cetaceans and avifauna are expected to be less sensitive to any potential impact from turbidity than fish larvae (described above), and therefore the evaluation of potential impacts to fish larvae provides a conservative evaluation of the level of potential impacts to marine fauna for this discharge.

Marine fauna found in the water column, such as fish, marine mammals and marine reptiles, are expected to actively avoid discharge plumes and associated turbidity and toxicity within the water column. Neff et al. (2000) states that drill cuttings are of little risk to water column biota due to WBM having low toxicity levels and will be rapidly diluted near the source.

As drill cuttings and fluid discharges within the operational area will be localised and rapidly diluted plus fish, marine mammals and marine reptile species will be transitory in nature, the impacts of these discharges will be negligible and are therefore not discussed further. All activities will be conducted in accordance with management actions outlined in the relevant recovery plans.

The operational area is situated within a distribution BIA for the white shark. Whilst the operational area is within a distribution BIA, interactions with white sharks are very unlikely due to their migratory nature and distance of the operational area from the preferred foraging areas around Bonney coast upwelling KEF and shelf environments in and deeper oceanic waters. Habitat damage is not listed as a threat in the white shark recovery plan (DSEWPaC, 2013a). All EPBC PMST (operational area) listed species are highly mobile, therefore, none are expected to be affected by minor localised drilling cuttings and fluids. There are no specific management actions relevant to seabed disturbance or water quality identified in the white shark recovery plan (DSEWPaC, 2013a).

The operational area overlaps with a pygmy blue whale foraging BIA and a southern right whale current core coastal range. The blue whale or southern right whale conservation management plans do not list water or sediment quality as a key risk. Planned discharge of drilling cuttings and fluids will ensure that the actions in the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b), that:

- activities will be managed such that any blue whale continues to utilise the area without injury and are not displaced from a foraging area (Commonwealth of Australia, 2015b).
- there will be no displacement of blue whales from a foraging area from drill cuttings and fluids.

Due to the distance from shore and from critical habitats for marine turtles, the potential for reduced water and sediment quality will not affect marine turtles. As per the Recovery Plan for Marine Turtles in Australia

(Commonwealth of Australia, 2017b), activities will be managed to ensure marine turtles are not displaced from identified habitat critical to the survival. The activity does not overlap with marine turtle BIAs.

Benthic habitats

Increases in turbidity from drill cutting discharges during the riserless drilling of the top-hole section (i.e. direct discharge to the seabed) are expected to be highly localised and limited to within close proximity of the well location. Given the short duration of riserless drilling, effects associated with this scenario are expected to be short-term, and no more significant than those described for surface discharges of drilling cuttings and fluids.

7.9.3.2 Change in Habitat

Environmental receptors with the potential to be exposed to a change in habitat through smothering of flora and fauna and alteration of seabed sediment distribution include:

- benthic habitat (soft sediment, macroalgae, soft corals)
- marine invertebrates

The magnitude of the impact depends on cuttings volumes, discharge location and substrate within the operational area.

Hinwood et al. (1994) explain that the main environmental disturbance from discharging drilling cuttings and fluids is associated with the smothering and burial of sessile benthic and epibenthic fauna. Neff et. al. (2010) suggests that SBDF-coated cuttings, tend to clump and settle rapidly as large particles over a small area near the discharge point and tend not to disperse rapidly (Neff, 2010) indicating that when drilling with SBDF, extent of dispersion is expected to decrease, but thickness of cuttings piles can be expected to increase.

Many studies have shown that the effects on seabed fauna and flora from the discharge of drilling cuttings with water based muds are subtle, although the presence of drilling fluids in the seabed close to the drilling location (<500 m) can usually be detected chemically (see Change in Water Quality caused by Planned Discharge - Drill Cuttings and Fluids) (e.g. Cranmer 1988, Neff et al. 1989, Hyland et al. 1994, Daan & Mulder 1996, Currie & Isaacs 2005, OSPAR 2009, Bakke et al. 2013).

Jones et al. (2006, 2012) compared pre- and post-drilling ROV surveys and documented physical smothering effects from WBDF cuttings within 100 m of the well. Outside the area of smothering, fine sediment was visible on the seafloor up to at least 250 m from the well. After three years, there was significant removal of cuttings particularly in the areas with relatively low initial deposition (Jones et al. 2012). The area impacted by complete cuttings cover had reduced from 90 m to 40 m from the drilling location, and faunal density within 100 m of the well had increased considerably and was no longer significantly different from conditions further away.

During October 2019 a 5.0 km by 4.6 km a seabed survey was undertaken area around the proposed Artisan-1 well location (Fugro, 2019). The survey identified:

- the seabed topography is dominated by exposed rock on the seabed.
- small patches of very thin transgressive coarse sand are present across the survey area.
- the seabed showed a scattered sessile biota on a sandy seafloor.
- no rocky reefs or outcrops were identified.

No key ecological features threatened ecological communities or habitats critical to the survival of the species were identified within the area of impact.

Although studies conducted by Hyland et al. (1994) noted negative response from sponges (disruption to feeding or respiration) to smothering resulting from drill cuttings, scattered biota including sponges were identified but no rocky reefs or outcrops where sponges, coral and more diverse fauna maybe present were identified within the operational area.

In general, research suggests that any smothering impacts within the operational area will be limited to 500 m from the well site, and full recovery is expected. Given the inert nature and limited volume of drill cuttings being discharged directly onto the seabed during riserless drilling, the impacts to benthic habitats are expected to be limited. Consequently, the potential impacts from smothering and alteration of seabed substrate are considered to be **Moderate (2)** as this type of event may result in localised short-term impacts but is not expected to affect local ecosystem functions.

7.9.3.3 Change in sediment quality

Environmental receptors with the potential to be exposed to a change in sediment quality include:

- benthic habitat (soft sediment, macroalgae, soft corals)
- marine invertebrates

As stated previously, Neff (2010), Hinwood et al. (1994) and the American Chemistry Council (2006) indicate larger particles of SBDF adhered to cuttings tend to clump together and settle to the seabed rapidly, with effects expected to be limited to within close proximity to the well location. Neff (2010) found that recolonisation of synthetic-based, drill fluid-cuttings piles in cold-water marine environments began within one to two years of ceasing discharges, once the hydrocarbon component of the cutting piles biodegraded. Additional studies indicate that benthic infauna and epifauna recover relatively quickly, with substantial recovery in deepwater benthic communities within three to ten years (Jones 2012).

No particular benthic values and sensitivities were identified within the operational area as per the Fugro (2019) seabed survey.

Although these studies are associated with cold, deep water environments, the recovery processes associated with drilling are expected to be similar and as species present in soft sediment are well adapted to changes in substrate, especially burrowing species (Kjeilen-Eilertsen et. al. 2004), a 10-year recovery period is considered suitable for providing a conservative indication of habitat recovery from this activity.

Consequently, the potential impacts from a change in sediment quality are considered to be **Moderate (2)** as this type of event may result in localised short-term impacts but is not expected to affect local ecosystem functions.

7.9.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: MODU Operations: Planned Discharge – Drilling Cuttings and Fluids	
ALARP decision context and justification	**ALARP Decision Context: Type B** The planned release of drill cuttings and adhered fluids offshore is a well understood and practiced activity both nationally and internationally. The potential impacts are well regulated via various treaties and legislation, which specify industry best practice control measures. These are well understood and implemented by the industry. No stakeholder objections or were claims raised with regards to this activity or similar activities during previous campaigns.

	For this aspect, the Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development (IFC, 2015) recommend that feasible alternatives for disposing of drilling cuttings should be evaluated to ensure that impacts are reduced to ALARP. In accordance with this, ALARP Decision Context B has been applied.		
Adopted Control Measures	**Source of good practice control measures**		
CM#19: Hazardous Materials Risk Assessment Process	The Beach Energy Hazardous Materials Risk Assessment Process assesses chemicals that have the potential to be discharged to the environment to ensure selection criteria are met. This control addresses Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development (IFC, 2015) – Drilling Fluids and Drilled Cuttings Guidance Number 59 that requires operators carefully select drilling fluid additives, considering their concentration, toxicity, bioavailability, and bioaccumulation potential.		
CM#22: Drill Fluid and Cuttings Management Plan	Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development (IFC, 2015) – Drilling Fluids and Drilled Cuttings Guidance Number 53 requires that consideration of discharges of drilling fluids including chemical content. Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development (IFC, 2015) – Drilling Fluids and Drilled Cuttings Guidance Number 59 requires that environmental hazards related to residual chemical additives on discharged cuttings are reduced through the drilling fluid selection.		
Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Reinject fluids and cuttings to subsurface formation	Elimination	Cuttings reinjection is a possible method for disposing of cuttings without discharge to the marine environment; however, significant time and costs are associated with site selection and reinjection requires a suitable, existing offshore well in proximity of the Artisan-1 well. Given the Artisan-1 well is a single exploration well within a petroleum permit that does not have existing production wells ready for abandonment, this is not a feasible option.	No
Contain and transfer cuttings to shore for treatment	Elimination	This option require access to dedicated facilities onshore available to treat cuttings, which do not currently exist. This control measure may result in increased offshore environmental impacts via generation of additional vessel movements and associated atmospheric emissions. In addition, this control may increase in environmental	No

		impact onshore (out of scope of this EP) due to emissions generated through transport, treatment and disposal. This control measure is considered to provide a small environmental benefit, that would be grossly disproportionate in time, cost and effort given the extent of impact from the discharge of drilling cuttings demonstrated to be localised and short-term.	
CM#22: Drill Fluid and Cuttings Management Plan Reconditioning and storage of synthetic-based drilling fluid for reuse	Substitution	Remaining synthetic-based drill fluid shall be contained on board the MODU for use when drilling future wells within the Otway Basin. When unable to be reconditioned offshore, whole synthetic-based drill fluid shall be transported to shore for reconditioning.	Yes
Riserless Mud Recovery (RMR) system	Equipment	RMR may be applied to recirculate drill fluids and cuttings from the top-hole section of the well, thus eliminating discharge to seabed (when applied in conjunction with containment and transfer to shore). RMR may also be implemented where shallow hazards are anticipated. Given low to no toxicity water- based fluids (e.g. water and gel sweeps) shall be used for riserless drilling sections and shallow hazards are not anticipated, there is limited technical benefit in using this system. Given the small extent and temporary nature of impacts from the discharge of water-based drill fluid and drill cuttings from the top-hole sections of the well, and the deep-water environment at the well locations not in the vicinity of formally-managed benthic communities, the application of RMR is considered grossly disproportionate to the negligible environmental benefit potentially gained.	No
Caisson discharge closer to seabed	Equipment	Based on the small extent and short-term impacts resulting from an increase in turbidity and smothering of benthic habitats, modifying the discharge depth of drill cuttings is not expected to result in a significant change to the severity of the impact.	No

Slim hole / coil tubing drilling	System	This drilling technique results in a reduction of the volume of cuttings produced. However, given Artisan-1 well is exploratory, and there is some uncertainty in the formation that may be encountered, Beach has adopted a conventional hole size to intersect the target reservoir, thus enabling greater fluid volume to maintain downhole pressure when compared with slim-hole design using a smaller volume of drilling fluids, and carry an elevated risk of a LOWC event.	No
CM#23: Solids Control Equipment (SCE)	Equipment	Additional equipment such as cuttings driers, thermal desorption and thermomechanical cleaning can be used to reduce the volumes of oil on cuttings. Equipment such as de-sanders, de-silters and centrifuges are used to reduce the solids content during treatment of used drilling fluids, while thermal desorption and thermal mechanical cleaning units are designed to clean oily residues from oily cuttings prior to their discharge. The addition of one or more of these control measures would result in a reduction in the overall level of environmental impact associated with the discharge of cuttings. Thermal desorption technology is not fitted to the MODU, due to this equipment not being available for rental and the significantly high purchase price, the elevated running costs (energy consumption) and the significant MODU modifications required to install, thermal desorption technology is not considered a practical option. Given the above, Beach considers the adoption of thermal desorption technology to be grossly disproportionate to the limited environmental benefit gained via a further reduction (likely in the order of 4 to 5%) in overall residual fluid on cuttings in a deep water, open-ocean environment where cuttings are likely to disperse rapidly. The MODU is to be fitted with industry-leading proven	Yes

		solids control systems to reduce lost fluid and ensure a maximum amount of drilling fluids are recycled and their useful life extended. The investment includes a package of newly installed NOV AX-1 shale shakers, an online centrifuging system and an NOV Verti-G cuttings dryer. Given the application of a Cefas / OCNS-aligned chemical selection process limiting the use of hazardous substances in drill fluids, and the installation of new conventional SCE aboard the MODU, Beach believes all reasonable measures have been implemented to treat drill cuttings and fluids.	
Seasonal timing of activity	Procedure	Seasonal timing was considered as a mitigation to avoid biologically important behaviours within the pygmy blue whale foraging BIA (January to April Gill et al., 2011) and migration BIA for the southern right whale (May-November; Bannister et al., 1996). The drilling activities may overlap these periods. Potential impacts to water quality from drill cuttings and fluids is expected to be very localised and temporary given the application of an OCNS aligned chemical assessment procedure and treatment controls detailed above, therefore impacts to cetaceans from reduced water quality are not expected. The MODU contracted to undertake the drilling activity is being mobilised from international waters for the sole purpose of undertaking the drilling program. The cost to contract and mobilise a MODU to commence drilling presents a significant cost (both financial and logistical), therefore a change in seasonally timing of the activity in is considered grossly disproportionate given the limited potential impact posed from drill fluid and cutting discharges to cetacean.	No

Impact evaluation summary	
Consequence rating	Moderate (2)
Residual impact category	Low-order impact

Acceptability assessment	
Policy compliance	The proposed management of the impact is aligned with the Beach Environment Policy.
To meet the principles of ESD	The activities were evaluated as having the potential to result in a **Moderate (2)** consequence thus is not considered as having the potential to result in serious or irreversible environmental damage. Discharges of drill cuttings and fluids will result in localised and temporary changes in water quality, such as increased toxicity and turbidity, which can potentially impact marine fauna. The predominantly dispersive and non-toxic nature of drilling-related discharges, the location of the operational area in deep (~70 m), highly mixed and relatively sparse open water, and lack of sensitive receptors mean that the discharges are localised. These discharges will result in localised changes in ambient water and sediment quality, including increased toxicity and smothering and alteration of the seabed, which can potentially impact benthic habitat and communities. Good practice control measures relevant to the activity will be implemented. Given the benthic habitat generally comprises soft sediment communities that are widespread and well represented in the region, impacts within the operational area surrounding the Artisan-1 exploration well are not considered significant. The habitat is expected to be homogenous in the area (to be verified via benthic surveys prior to drilling), as such, impacts are not expected to result in fragmentation, isolation or disturbance to other communities and ecosystems, nor adversely impact on biodiversity or ecological integrity. The operational area overlaps with a pygmy blue whale foraging BIA and a southern right whale current core coastal range. The blue whale or southern right whale conservation management plan do not list water or sediment quality as a key risk (Section 3.13.2). Planned discharge of drilling cuttings and fluids will ensure that the actions in the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b), that: • activities will be managed such that any blue whale continues to utilise the area without injury and are not displaced from a foraging area. • there will be no displacement of blue whales from a foraging area from drill cuttings and fluids. There are no specific management actions relevant to seabed disturbance or water quality identified in the white shark recovery plan (DSEWPaC, 2013a).
Internal context	Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	No objections or claims have been raised during stakeholder consultation regarding the planned discharges of drilling cuttings and fluids.
Other requirements	Legislation and other requirements considered as relevant control measures include World Bank (2015) Environmental, Health, and Safety

	Guidelines Offshore Oil and Gas Development. This guideline is considered to provide examples of good industry practices when managing impacts from specific industries. The planned discharge of drilling cuttings and fluids will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Compliance against EPOs, EPSs shall be monitored in accordance with inspection / audit schedule. Impacts shall be monitored and reported via the incident management procedure. Any complaints received from stakeholders are handled in accordance with the process outlined in Section 9.
Acceptability outcome	**Acceptable**

7.10 Planned marine discharges - cement

7.10.1 Hazards

Cement will be discharged at both the surface and the seabed during drilling, well suspension and well abandonment activities.

Cumulative impacts regarding planned marine discharges are assessed in Section 7.7.

7.10.2 Known and potential environmental impacts

Planned discharge of cement has the potential to result in:

- increased turbidity of the water column from surface discharges; and
- smothering of benthic habitat and fauna by seabed discharges.

Toxicity impacts are not predicted as cement is Considered to Pose Little or No Risk to the Environment (PLONOR) (Cefas, 2018).

7.10.3 Consequence evaluation

Increased turbidity of the water column from surface discharges

Cement fluids are discharged to the marine environment as part of testing the cementing unit (up to 8 m^3) on completion of each cementing job (1 m^3 discharged up to six times) and in the event the cement spoils or there is an issue with the cementing operations (up to 22 m^3). The discharge is a combination of cement slurry and mix or wash water.

Modelling of a release of 18 m^3 of cement wash water by de Campos et al. (2017) indicated an ultimate average deposition of 0.05 mg/m^2 of material on the seabed; with particulate matter deposited within the three-day simulation period. Given the low concentration of the deposition of the material, it is therefore expected that the in-water suspended solids (i.e. turbidity) created by the discharge is not likely to be high for an extended period, or over a wide area; even when scaling this volume up to the expected discharge (14 m^3 to 36 m^3).

Modelling of larger cement discharges (approximately 78 m^3 over a one-hour period) was undertaken for BP (2013). Results of this modelling showed that within two hours suspended solid concentrations ranged between 5-50 mg/L within the extent of the plume (approximately 150 m horizontal and 10 m vertical); and by four hours post-discharge, that concentrations were <5 mg/L. Given the estimated rate of cement discharge between 14 m^3 to 36 m^3 are much less that the volume estimated by BP, it is expected that the concentration of suspended sediments would be lower than predicted in the modelling.

Based on the BP modelling the extent of increased turbidity is estimated to be 150 m from the MODU for a duration of four hours after each discharge. The modelling showed that the extent of the plume was only 10 m vertically and impacts to sediments and benthic biota including invertebrates is not predicted. Within the 150 m extent of potential impact potential receptors to change in water quality would be plankton, fish, turtles and marine mammals.

Though plankton may be sensitive to some aspects of marine discharges this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to suspended solids of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that are ecologically significant.

Jenkins and McKinnon (2006) reported that levels of suspended sediments greater than 500 mg/L are likely to produce a measurable impact upon larvae of most fish species, and that levels of 100 mg/L will affect the larvae of some species if exposed for periods greater than 96 hours. Jenkins and McKinnon (2006) also indicated that levels of 100 mg/L may affect the larvae of several marine invertebrate species and that fish eggs and larvae are more vulnerable to suspended sediments than older life stages. Neither the modelling by de Campos et al (2017) or BP (2013) suggest that suspended solids concentrations from a discharge of the cement washing will be at or near levels required to cause an effect on fish or invertebrate larvae, i.e. predicted levels were well below a 96-hr exposure at 100 mg/L, or instantaneous 500 mg/L exposure.

Fish species, including commercial species maybe present within the area of impact. There are no BIAs or protected habitats and commercial fishing for fish species has not been identified within the area of impact. No features have been identified where site attached species would be present. As fish species would be transient in the area of impact, impacts are not predicted due to the low toxicity of the suspended solids and rapid dilution.

The area of impact is within the distribution BIA for white shark, although no critical habitats or behaviours are known to occur. Sharks will be transient through the area thus impacts are not predicted. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify MODU discharges or equivalent as a threat. As these species would be transient impacts are not predicted due to the low toxicity of the suspended solids and rapid dilution.

No turtle BIAs are located within the area of impact though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) though not specifically from MODUs. As these species would be transient impacts are not predicted due to the low toxicity of the suspended solids and rapid dilution.

Marine mammals can actively avoid plumes, limiting exposure. The area of impact overlaps the pygmy blue whale foraging BIA. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) does not identify discharges from MODUs as a threat to the recovery of these species. It would be highly unlikely that pygmy blue whales would be foraging within 150 m of the MODU as there are no features where krill would be in abundance. As such these species are likely to be transient within the area of potential impact, impacts are not predicted due to the low toxicity of the suspended solids and rapid dilution.

The area of impact overlaps the southern right whale current core coastal range. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify discharges from MODUs as a threat to the recovery of these species. These species are likely to be transient thus impacts are not predicted due to the low toxicity of the suspended solids and rapid dilution.

The extent of the impact is predicted to be 150 m from the MODU with a duration of four hours after each discharge. The severity is assessed as minor based on:

- receptor exposure would be short term.
- cement is considered to pose little of no risk to the environment.
- no sensitive resident receptors were identified within the 150 m area that may be affected.
- discharges will rapidly disperse in the marine environment.

Smothering of benthic habitat and fauna by seabed discharges.

It is estimated that approximately 15 m^3 of cement will be discharged to seabed per well. BP (2013) modelled a 200 t cement discharge with the extent of potential impact from this discharge expected to be limited to 10 m of the seabed discharge point. 1 m^3 of cement is approximately 2.4 t. So, 15 m^3 of cement would be 36 t, thus the area of impact would be expected to be less than 10 m.

During October 2019 a 5.0 km by 4.6 km a seabed survey was undertaken area around the proposed Artisan-1 well location (Fugro, 2019). The survey identified:

- the seabed topography is dominated by exposed rock on the seabed.
- small patches of very thin transgressive coarse sand are present across the survey area.
- the seabed showed a scattered sessile biota on a sandy seafloor.
- no rocky reefs or outcrops were identified.

No key ecological features threatened ecological communities or habitats critical to the survival of the species were identified within the area of impact.

The extent of the area of impact is predicted to be 10 m for a duration of up to months to years will the disturbed area recolonises. The severity is assessed as minor based on:

- the area of impact is very small at 10 m.
- no sensitive or protected benthic habitat or species have been identified in the area of impact.
- the benthic habitat within the area of impact is likely to consist of exposed rock with scattered sessile biota.

7.10.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges cement	
ALARP decision context and justification	**ALARP Decision Context: Type A** Impacts from planned cement discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the impact consequence is rated as minor (1) applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#19: Hazardous Material Risk Assessment Process	All chemicals that will be or have the potential to be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
CM#24: Cementing procedure	Cementing procedures shall be developed to minimise the amount of cement discharged to the marine environment.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Cement discharges were assessed as having a minor (1) consequence which is not considered as having the potential to result in serious or

	irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding planned marine discharges.
Other requirements	Cement discharges will be managed in accordance with legislative requirements. Cement discharges will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with cement discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. Therefore, the monitoring is not proposed.
Acceptability outcome	**Acceptable**

7.11 Establishment of invasive marine species

7.11.1 Background information

If the MODU is mobilised from overseas the drilling contractor will 'dry-tow' the MODU to Australian waters via a heavy lift vessel (HLV). The MODU is likely to be offloaded from the HLV within Port Philip Bay (Port of Melbourne). Alternatively, the MODU may already be in Victorian waters. In either case the MODU will be mobilised to the operational area from Victorian waters.

7.11.2 Hazards

The introduction of marine pests could occur during vessel and MODU operations as a result of:

- discharge of ballast water containing foreign species.
- translocation of species through biofouling of the MODU or vessel hull, anchors and/or niches (e.g. sea chests, bilges and strainers).
- disposal of contaminated waste and materials.

Successful IMS invasion requires the following three steps:

- colonisation and establishment of the marine pest on a vector (e.g., MODU hull) in a donor region (e.g., home port).
- survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
- colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

7.11.3 Known and potential environmental risks

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. However, establishment of introduced marine species is mostly likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

If the risk of establishment of IMS is realised, the following known and potential environmental impacts may occur:

- change in ecosystem dynamics.
- changes to the functions, interests or activities of other users.

Change in ecosystem dynamics may include reduction in native marine species diversity and abundance, displacement of native marine species, socio-economic impacts on commercial fisheries, and changes to conservation values of protected area.

7.11.4 Consequence evaluation

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. Establishment of introduced marine species is most likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

In the event of an IMS being introduced to the marine environment, successful colonisation is dependent upon suitable substrate availability. The operational area does not present a location conducive to marine pest survival because it is located in deep waters with the majority of the operational area in water greater than 70 m.

IMS introduced during the activity has the potential to impact ecosystem dynamics. As a result of a change in ecosystem dynamics, further impacts may occur, which include change in the functions, interests or activities of other users.

Receptors potentially impacted by a change in ecosystem dynamics include:

- marine invertebrates
- benthic habitat (soft sediment, macroalgae, soft corals)
- commercial fisheries.

Given the distance from planned operations (32 km offshore), no impacts to Australian Marine Parks are predicted.

7.11.4.1 Marine invertebrates and benthic habitats

IMS are likely to have little or no natural competition or predators, thus potentially outcompeting native species for food or space, preying on native species, or changing the nature of the environment. It is estimated that Australia has more than 250 established marine pests, and that approximately one in six introduced marine species becomes a pest (Department of the Environment, 2015). Once established, some pests can be difficult to eradicate (Hewitt et al., 2002) and therefore there is the potential for a long-term or persistent change in habitat structure. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002).

The chances of successful colonisation in the Otway region are considered small given:

- The Fugro seabed survey (2019) around the proposed Artisan-1 well location identified that the seabed is dominated by exposed rock with very thin transgressive coarse sand and no rocky reefs or outcrops. This type of habitat is not conducive to the establishment of IMS and is outside of coastal waters where the risk of IMS establishment is considered greatest (BRS, 2007).
- the well locations are geographically isolated from other subsea or surface infrastructure which might be suitable for colonisation.
- the operational area does not present a location conducive to marine pest survival because it is located in deep waters with the majority of the operational area in water greater than 70 m.

Areas of higher value or sensitivity are located away from the Artisan-1 well site with Twelve Apostles Marine National Park on the Victorian coast approximately 35 km away. While unlikely, if an IMS was introduced, and if it did colonise an area, it is expected that any colony would remain fragmented and isolated, and only within the vicinity of the wells (i.e. it would not be able to propagate to nearshore environments, and protected marine areas present in the wider region).

Given the impact of a successful IMS colonisation has the ability to significantly impact local species and thus change local epifauna and infauna populations permanently, the consequences have been evaluated as **Serious (3).** However, it is considered such an event is **Remote (1)** due to the unfavourable conditions within the operational area required for colonisation. As outlined in Section 7.11.5 Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered **low**.

7.11.4.2 Commercial fisheries

The introduction of IMS has the potential to result in changes to the functions, interest or activities of other users, including commercial fisheries. Marine pest species can deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific Seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (DSE, 2004). However, areas suitable for commercial scallop fishing are not expected near the well locations; commercially suitable scallop aggregations occur in the waters of eastern Victoria (Koopman et al. 2018).

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

Whilst it has been assessed that the introduction of an IMS would have a **Serious (3)** impact on state and Commonwealth fisheries the likelihood has been assessed as **Remote (1)**. Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered **low**.

7.11.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Establishment of invasive marine pests	
ALARP decision context and justification	**ALARP Decision Context: Type B** On the basis of the impact assessment completed, Beach considers the control measures described are appropriate to manage the impacts associated with the risk of introduction and establishment of IMS. The Victorian DJPR have expressed interest in the management of IMS in Victorian State waters.
Adopted Control Measures	**Source of good practice control measures**
CM#25: MO 98: Marine pollution – anti-fouling systems	Marine Order 98 (Marine pollution — anti-fouling systems) 2013 provide for controls on anti-fouling systems and for the survey, inspection and certification of ships for those systems. Subject to class, vessels operating in Australian waters are required to hold a valid an anti-fouling system certificate.
CM#26: Australian Ballast Water Management Requirements	The Australian Ballast Water Management Requirements (DAWR 2017) describe the requirements for ballast water management specifically: • vessel ballasting operations must be undertaken as per an approved Ballast Water Management Plan (BWMP). • international vessels entering Australian waters require an International Ballast Water Management Certificate (BWMC). • vessels that carry ballast water must maintain a complete and accurate Ballast Water Record System (record book).
CM#27: National Biofouling Management Guidance for the Petroleum Production and Exploration Industry	The National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009) recommends and provides information on undertaking a vessel specific risk assessment to identify the level of risk a vessel poses, and the level of controls required to reduce IMS introduction risks. The National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009) recommends that routine cleaning, maintenance, drying and storage of

	ROVs and in-water equipment to maintain a low risk of any biofouling mediated translocation of marine pests.
CM#28: Australian Biofouling Management Requirements (Proposed) consistent with International Maritime Organization (IMO) 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species	The proposed Australian Biofouling Management Requirements, require a biofouling management plan and record book consistent with IMO Biofouling Guidelines
CM#29: Beach Domestic IMS Biofouling Risk Assessment Process	All MODUs, vessels and submersible equipment mobilised from domestic waters to undertake offshore petroleum activities within the operational area must complete the Beach Domestic IMS Biofouling Risk Assessment Process as detailed in the Beach Introduced Marine Species Management Plan (S400AH719916) prior to the initial mobilisation into the operational area.

Additional controls assessed

Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Only use vessels that are based in Victoria to reduce the potential for introducing IMS.	Equipment	Specialised anchor handling and tug supply (AHTS) vessels are required to support the proposed drilling activity. Using vessels that are based in Victoria (if available) may reduce the likelihood of introducing an IMS but this would depend on the IMS risk level of the port where the vessel is based. The control measures that are to be implemented are required to be undertaken for vessels from any port in Victoria or Australia. Thus, there is limited environmental benefit associated with implementing this response.	Not selected

Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	• no impacts to MNES are expected. • there are no EPBC management plans (management plans, recovery plans or conservation advice) which relate specifically to IMS introduction and establishment as a threat. The activity does not take place within an AMP, and any impacts will not affect the natural values of an AMP. • the ability for an IMS to establish itself is unlikely due to the sparse nature of benthic habitats and communities and unfavourable oceanic conditions within the operational area. • the operational area is approximately 32 km (17 nm) from shore and BRS (2007) estimated the probability of an IMS incursion as

	2% chance at 24 nm which was also based on shallower water (50 m, compared to 70 m). • an EPBC PMST did not identify any benthic habitats or communities threatened or migratory species, or any threatened ecological communities within the operational area. • there is potential for a localised impact to benthic communities and fisheries resulting in a **Serious (3)** consequence. Although the habitat with the potential to be impacted is characterised by soft sediment communities, because of the potential for serious impacts, this aspect is considered as having the potential to (although very unlikely) affect biological diversity and ecological integrity. • there is little uncertainty associated with this aspect as the activities are well known, the cause pathways are well known, and activities are well regulated and managed. • it is not considered that there is significant scientific uncertainty associated with this aspect. Therefore, the precautionary principle has not been applied. • good practice control measures relevant to the activity will be implemented.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding the introduction or establishment of invasive marine pests in relation to the drilling activity.
Other requirements	The impact will be managed in accordance with legislation requirements and guidance, including: • Offshore Installations - Biosecurity Guide (DAWR 2019) • National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009) • Australian Ballast Water Management Requirements (DAWR 2017) with gives effect to the Biosecurity Act 2015; International Convention for the Control and Management of Ships’ Ballast Water and Sediments (Ballast Water Convention) and relevant guidelines or procedures adopted by the Marine Environment Protection Committee of the International Maritime Organization (IMO) • IMO Biofouling Guidelines
Monitoring and reporting	Impacts as a result of the introduction of marine invasive species will be monitored and reported in accordance with Section 8.9.1.
Acceptability outcome	**Acceptable**

7.12 Collision with marine fauna

7.12.1 Hazards

The use of vessels can lead to collision with marine fauna.

7.12.2 Known and potential environmental impacts

Impacts to fauna can be injury or death.

Disturbance to fauna from vessels can occur and this is addressed in Section 7.4 underwater noise emissions.

7.12.3 Consequence evaluation

Marine fauna species most susceptible to vessel strike are typically characterised by one or more of the following characteristics:

- commonly dwells at or near surface waters;
- often slow moving or large in size;
- frequents areas with a high levels of vessel traffic; and
- fauna population is small, threatened, or geographically concentrated in areas that also correspond with high levels of vessel traffic.

The National Strategy for Mitigating Vessel Strike of Marine Mega-fauna (Commonwealth of Australia, 2017a) identifies cetaceans and marine turtles as being vulnerable to vessel collisions.

Three marine turtle species may occur within the operational area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (DotEE, 2017d) identified vessel strike as a threat.

Two species of pinniped may occur within the operational area; the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Nine whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); no other important behaviours were identified. The operational area intersects the southern right whale current core coastal range and a foraging BIA for the pygmy blue whale. The Conservation Management Plan for the blue whale and for the southern right whale and Conservation Advice for the sei whale, fin whale and humpback whale identify vessel strike as a threat.

Protected species vulnerable to vessel strikes are identified as being transient in the area except for pygmy blue whales within the foraging BIA. Pygmy blue whales are likely to be foraging within the BIA (January through to April (Gill et al., 2011) which overlaps the period of the activity. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) detail that collisions will impede the recovery of blue whale populations if a sufficient number of individuals in the population lose reproductive fitness or are killed.

The occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.

The extent of the area of where the risk of a vessel collision with fauna may occur is within the operational area (2 km from the well) and the risk could occur during the 55 days while the activity is undertaken. The severity is assessed as moderate and likelihood as highly unlikely based on:

- within the operational area vessels will be slow moving to stationary.
- the occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.
- if an incident occurred, it would be restricted to individual fauna.

7.12.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges	
ALARP decision context and justification	**ALARP Decision Context: Type A** The risk of a vessel collision with marine fauna are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the risk is rated as low applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#4: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels.
CM#30: Vessel speed restrictions	The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017 (Commonwealth of Australia, 2017a) identifies that speed is a concern when considering collision risk and the outcome and that slower moving vessels provide greater opportunity for both fauna and vessel to avoid collision. Large, high-speed vessels, in particular, have become a major concern as they are capable of travelling at speeds of up to 35 to 40 knots, which correlates to an increase in collisions (Weinrich 2004; Ritter 2010 cited in Commonwealth of Australia, 2017a). The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017(Commonwealth of Australia, 2017a) does not make any recommendations in relation to a maximum vessel speed, but case studies within the strategy have implemented a 10 knot speed limit in sensitive areas. Furthermore, the strategy details, according to Laist et al. (2001), 89 % of incidences where the whale was severely hurt or killed occurred at vessel travelling speeds greater than 14 knots and were most serious in large vessels (> 80 m). Based on this information vessel speeds within the operational area will be restricted to 10 knots.
Consequence rating	Moderate (2)
Likelihood of occurrence	Highly Unlikely (2)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a vessel collision with marine fauna was assessed as low which is not considered as having the potential to result in serious or

	irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding vessel collision with marine fauna.
Other requirements	Interactions with marine fauna will be managed in accordance with legislative requirements. Vessel collision with marine fauna if it occurred will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). Actions from the recovery plan applicable to vessel collision will be implemented. • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice. Actions from the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) applicable to the activity to minimise vessel collisions have been addressed as per: • ensure all vessel strike incidents are reported in the National Ship Strike Database. Vessel collision with protected marine fauna are required to be reported as detailed in Section 8.9.1 • ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented. Section 7.12 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP.
Monitoring and reporting	Vessel collision with protected marine fauna area required to be reported as detailed in Section 8.9.1.
Acceptability outcome	**Acceptable**

7.13 Entanglement of fauna

7.13.1 Hazards

Eight anchors are prelaid within the operational area (2 km from the Artisan-1 well location). The anchors will remain insitu until drilling is completed. Depending on contracting of a suitable MODU, drilling will occur within the period from Q3 2020 to the end of 2021. Thus, the anchors may remain insitu for up to 18 months.

7.13.2 Known and potential environmental impacts

The anchors are in ~ 70 m of water and consist of anchor chain and surface buoy. There is a risk that marine fauna could become entangle in the anchor chain that is between the seabed and surface buoy.

Three marine turtle species may occur within the operational area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (DotEE, 2017d) identifies engagement in marine debris as a threat but not for anchor chains.

Two species of pinniped may occur within the operational area; the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Nine whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); no other important behaviours were identified. The operational area intersects the southern right whale current core coastal range and a foraging BIA for the pygmy blue whale. The Conservation Management Plan for the blue (Commonwealth of Australia, 2015c) and for the southern right (DSEWPaC, 2012a) whale identify entanglement in marine debris and fishing equipment as a threat but not for anchor chains.

7.13.3 Consequence evaluation

Several papers (Harnois et al. 2015; Murphy et al. 2012; Benjamins et al. (2014) have recently been published in relation to the assessment of entanglement risks to marine fauna due to offshore renewable energy mooring systems. These mooring systems are more aligned with a MODU mooring system than a vessel mooring system due to the use of heavy chains. Limited information was found on entanglement risks from MODU anchors while connected to the MODU or insitu with a buoy. There is no increased risk with the anchor moorings being attached to a buoy than to a MODU due to the weight and width of the anchor chain and the weight of the buoy (29 MT) which will maintain tautness on the anchor chain.

Harnois et al. (2015) details that no entanglement has been reported in oil and gas moorings which, however, does not mean it did not occur. The NERA Environment Plan Reference Case Anchoring of Vessels and Floating Facilities (DIIS 2018) which covers the installation of moorings, buoys, equipment or other infrastructure and wet storage of anchor chains for a period of up to 2 years details that due to the relatively small footprint of infrastructure within the water column (e.g. anchor lines), anchoring activities from vessels and facilities are unlikely to significantly affect the movement (including migration) of marine megafauna. Any deviation that may occur would be localised and temporary in nature. The Reference Case does not assess or provide specific controls given the low level of risk.

Murphy et al. (2012) details that following a collision with power cables or mooring elements, marine mammals may be subsequently at risk of entanglement. The entanglement risk posed by cables is dependent on their thickness (with thin cables providing a greater risk), their tension (with slack cables being more dangerous than taut ones), position in the water column (horizontal cables being considered more dangerous than vertical ones) and the materials chosen for their outer casing (smooth cables being less likely to entangle than rough ones). This is supported by Harnois et al. (2015) who reviewed physical parameters of mooring system affecting the relative risk of entanglement and identified that the taut configuration has the lowest relative risk of entanglement, while the highest relative risk occurs with catenary moorings with chains and nylon ropes or with catenary moorings with accessory buoys.

As detailed in Figure 4-1 the insitu anchor cable will be taut, vertical, with thick chain links that though not smooth are not as flexible of ropes or cables and hence are less likely to pose an entanglement risk.

The extent of the area of where the risk of entanglement in the MODU anchor chains could occur is within the operational area (2 km from the well) and the risk could occur during the 18 months that the anchors are present. The severity is assessed as minor and likelihood as highly unlikely based on:

- no entanglement has been reported in oil and gas moorings.
- the insitu anchor mooring configuration has the lowest relative risk of entanglement.
- the Conservation Management Plan for the blue whale (Commonwealth of Australia, 2015c) and for the southern right (DSEWPaC, 2012a) identify entanglement in marine debris as a minor consequence for which the definition is: individuals are affected but no affect at a population level. Thus, as no entanglement with oil and gas moorings have been reported or identified as a threat within the conservation management plans the severity would be less.

7.13.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Air emissions	
ALARP decision context and justification	**ALARP Decision Context: Type A** Entanglement of fauna in anchor moorings is an unlikely risk that has not been recorded to date or identified as a risk in protected species management plans. No objections or claims have been raised by stakeholders in relation to entanglement of fauna in anchor moorings. The impact consequence is rated as minor (1) and good industry practice in relation to the mooring design has been applied.
Adopted Control Measures	Source of good industry practice control measures
CM#17: Mooring plan	Prelaid anchors are laid as per Mooring Plan to ensure the anchor chains from seabed to surface buoys is taut.
CM#12: Anchor buoy monitoring	The position of the anchor buoys will be monitored to ensure that the buoys and anchor chains remain as per the Mooring Plan. Each anchor buoys has a device tracking and control (DTAC) transmitter which transmits the buoy position every 12 hours. A geofence has been set at 100 m around each buoy which will notify the monitoring company if the buoy has moved. A helicopter or vessel will transit to site within 48 to initially inspect the buoys if: • DTAC readings are not functional. • Buoys are outside of the 100 m geofenced area for three consecutive DTAC readings. To remediate or recover buoys will require a suitable vessel, such as an anchor handler, able to be mobilised within 5 days of initial notification (or within 24 hours if already crewed and operational). If a buoy has parted from the anchor chain, attempts will be made to recover it.

	If the buoy is not recoverable it will be reported to If the buoy is not recoverable it will be reported to AMSA who will issue a Notice to Mariners. Three consecutive readings is deemed appropriate to initiate a visual inspection of the buoys as it allows confirmation that the readings are not anomalies. As a suitable vessel to remediate or recover the buoy may take up to 5 days to man and mobilise Beach has put in place the additional control of mobilising a smaller vessel or helicopter to conduct a visual inspection to confirm the status of the buoys.	
CM#13: Anchor buoy inspection	A visual inspection of the anchor buoys will be undertaken at least 6-monthly to ensure they are maintained. Six monthly inspections are a typical timeframe for offshore buoys.	
Additional controls assessed		
Control	**Cost/Benefit Analysis**	**Control Implemented?**
Remove anchors and re-lay closer to the time of drilling.	Removal and re-lay of anchors will take up to 10 days for each activity with an estimated cost of $500K plus storage of $150K. Removal and re-lay would increase (up to double) the disturbance of the seabed. It would also increase vessel activity associated impacts and risks based on an additional 20 days of vessel activity. These increase in impacts and risks are not likely to be significant. Entanglement of fauna in MODU anchor moorings is an unlikely risk that has not been recorded to date or identified as a risk in protected species management plans. There is no increased risk with the anchor moorings being attached to a buoy than to a MODU due to the weight and width of the anchor chain and the weight of the buoy (23 MT) which will maintain tautness on the anchor chain. Based on the low level of risk to marine fauna the benefits of leaving the anchors insitu outweigh the costs.	No
Consequence rating	Minor (1)	
Likelihood of occurrence	Highly Unlikely (2)	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	The risk of a fauna entanglement in the anchor chains while the anchors ae insitu was assessed as low which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.	
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.	

External context	There have been no stakeholder objections or claims regarding fauna entanglement.
Other requirements	Interactions with marine fauna will be managed in accordance with legislative requirements. Entanglement of marine fauna if it occurred will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). Actions from the recovery plan applicable to vessel collision will be implemented. • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Entanglement with protected marine fauna area required to be reported as detailed in EP Section 8.9.1
Acceptability outcome	**Acceptable**

7.14 Unplanned marine discharges - waste

7.14.1 Hazards

Waste maybe accidently blown overboard off the vessels or MODU.

7.14.2 Known and potential environmental impacts

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

7.14.3 Consequence evaluation

Waste accidently released to the marine environment may occur within the operational area.

The Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (Commonwealth of Australia, 2018) details harmful marine debris impacts on a range of marine life, including protected species of birds, sharks, turtles and marine mammals. Harmful marine debris refers to all plastics and other types of debris from domestic or international sources that may cause harm to vertebrate marine wildlife. This includes land sourced plastic garbage (e.g. bags, bottles, ropes, fibreglass, piping, insulation, paints and adhesives), derelict fishing gear from recreational and commercial fishing activities and ship-sourced, solid non-biodegradable floating materials lost or disposed of at sea.

Waste accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement. Impacts will be restricted in exposure and quantity and will be limited to individual fauna.

The operational area overlaps foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. No habitat critical to the survival of birds occur within the operational area. Marine debris is identified as a threat in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a).

Three marine turtle species (or species habitat) may occur within the operational area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) identified marine debris as a threat.

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

Nine whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); no other important behaviours were identified. The operational area intersects a foraging BIA for the pygmy blue whale and the southern right whale current core coastal range.

The Conservation Management Plan for the blue whale and for the southern right whale and Conservation Advice for the sei whale, fin whale and humpback whale do not identify marine debris as threat.

The extent of the area of where the risk of unplanned waste being discharged to the marine environment is within the operational area and the risk could occur during the 55 days while the activity is undertaken. The severity is assessed as **Minor (1)** and remote as unplanned release of waste is uncommon; if waste was lost overboard impacts would be restricted in exposure and quantity and would be limited to individual fauna.

7.14.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges	
ALARP decision context and justification	**ALARP Decision Context: Type A** The risk of a marine debris impacts to marine fauna is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the risk is rated as low applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#31: MO 95: Marine Pollution Prevention – Garbage	Marine Order Part 95 (Marine pollution prevention — garbage gives effect to MARPOL Annex V. MARPOL is the International Convention for the Prevention of Pollution from Ships and is aimed at preventing both accidental pollution, and pollution from routine operations. Specifically, MARPOL Annex V requires that a garbage / waste management plan and garbage record book is in place and implemented.
Consequence rating	Minor (1)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a marine fauna injury or death from unplanned discharge of waste was assessed as low which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding marine fauna injury or death from unplanned discharge of waste.
Other requirements	Waste on board the vessels and MODU will be managed in accordance with legislative requirements. Marine fauna injury or death from unplanned discharge of waste if occurred will not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a).

	• impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Unplanned discharge of waste is required to be reported as per Section 8.10.2.
Acceptability outcome	**Acceptable**

7.15 Minor Spills

7.15.1 Hazards

The operation of the MODU and support vessels includes handling, use and transfer of hydrocarbons and chemicals with the following were identified as potentially leading to a loss of containment event:

- use, handling and transfer of hydrocarbons and chemicals on board
- hydraulic line failure from equipment
- transfer of hazardous materials between the MODU and vessel (refuelling)

7.15.2 Known and potential environmental impacts

The known and potential environmental impacts of a diesel spill are:

- change in water quality

As a result of a change in water quality, further impacts may occur, which include:

- injury / mortality to fauna
- change in fauna behaviour
- change in ecosystem dynamics
- changes to the functions, interests or activities of other users

7.15.3 Consequence evaluation

An evaluation of the types of minor spill events was completed to determined indicative volumes associated with each type of event. Both hydraulic line failure and use of hazardous materials onboard were associated with small volume spill events – with the maximum volume based upon the loss of an intermediate bulk container ~1 m^3.

AMSA (2015) suggests the maximum credible spill volume from a refuelling incident with continuous supervision is approximately the transfer rate over 15 minutes. Assuming failure of dry-break couplings and an assumed ~200 m^3/h transfer rate (based on previous operations), this equates to an instantaneous spill of ~50 m^3. Given the volume associated with this type of incident is much larger, it has been conservatively applied to conduct the risk consequence evaluation for this event.

To evaluate the potential extent of this scale of hydrocarbon spill, an Automated Data Inquiry for Oil Spills (ADIOS) model was generated for an instantaneous 50 m^3 spill of MDO, with results showing that:

- within 6-hours of the spill approximately 20% of the product evaporates, 64% disperses with 16% remaining on the sea surface (approx. 8 m^3);
- The surface life for an instantaneous diesel spill of 50 m^3 from a refuelling incident is estimated at 12 hours;
- In this time, surface diesel may travel up to 14.7 km, based on an estimate in which the surface spill will travel at 100% of the speed and direction of ambient currents, and 3% of speed and direction of local winds; and
- Given the release location at the Artisan-1 well site, no shorelines are predicted to be impacted.

Given the propensity for MDO to rapidly disperse and thin below conservative environmental impact thresholds of 10 g/m^2 near the release location (as indicated by results for larger potential MDO spills – see Section 7.16), it is considered unlikely to result in fauna injury or mortality, a change in ecosystem dynamics or result in changes to the functions, interests or activities of other marine users in the area.

The potential consequence of a minor hydrocarbon spill at the Artisan-1 well location would be limited to a localised and temporary change in water quality in the vicinity of the release, and the potential change to fauna behaviour within surface waters affected by the spill, such as avoidance. As such, the consequence of this scenario has been evaluated as **Minor (1)** given there is unlikely to be a lasting effect to biological and physical environment in an area that is not formally managed.

7.15.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges	
ALARP decision context and justification	**ALARP Decision Context: Type A** The risk of a minor spill is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to minor spills during drilling activities. As the risk is rated as low applying good industry practice (as defined in Section 6.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#32 Bunkering procedure	Drilling Contractor management system includes managed bunkering operations.
CM#33: Drain management	Drilling Contractor management system includes the lock-out of overboard discharge drains with potential to release hazardous substances, inclusive of hydrocarbons.
CM#34: Spill containment	Drilling Contractor management system includes provision to maintain spill containment and clean-up equipment aboard the MODU and clean spills aboard the MODU to prevent release to the marine environment.
CM#35: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA's MO 91 [Marine Pollution Prevention – oil], a SMPEP or SOPEP (according to class) is required to be developed based upon the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. To prepare for a spill event, the SMPEP/SOPEP details: • response equipment available to control a spill event; • review cycle to ensure that the SMPEP/SOPEP is kept up to date; and • testing requirements, including the frequency and nature of these tests. • in the event of a spill, the SMPEP/SOPEP details: • reporting requirements and a list of authorities to be contacted; • activities to be undertaken to control the discharge of hydrocarbon; and • procedures for coordinating with local officials.

	Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
Consequence rating	Minor (1)
Likelihood of occurrence	Unlikely (3)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a minor spill assessed as low and the consequence was assessed as minor which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding minor spills.
Other requirements	Minor spills will be managed in accordance with legislative requirements. Minor spills not: • impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • impact the recovery of sei, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Minor spills are required to be reported as per Section 8.9.1 and Section 8.10.2.
Acceptability outcome	**Acceptable**

7.16 Quantitative hydrocarbon spill modelling

Beach commissioned RPS Australia West Pty Ltd (RPS) to conduct quantitative spill modelling for two credible, yet hypothetical, worst-case hydrocarbon release scenarios:

Scenario 1: a 222,224 bbl (2584 bbl/d) subsea release of condensate over 86 days.

This loss of well control (LOWC) scenario represents an unrestricted open-hole release from the Artisan-1 well location and has been identified in alignment with methodology detailed within the Society of Petroleum Engineers (SPE) Technical Report: Calculation of Worst-Case Discharge (WCD) (April 2015). The modelled duration of this release represents the time determined to implement a full dynamic well kill via the drilling of a relief well at the Artisan-1 well location.

Beach has modelled the WCD assuming that the intersected reservoir is similar in quality to Thylacine and contains similar hydrocarbons. These reservoirs have high permeability and contain a gas with a relatively low condensate – gas ratio of circa 13 bbl/MMscf. The modelling assumes a reservoir pressure on the same pressure – depth trend as Thylacine and that the loss of control happens with no pipe in the hole i.e. the flow rate is only constrained by the hole size and casing already in the hole (nominally 8.5” hole with 7” casing above). The flow rate is therefore controlled by the pressure differential between the reservoir and the seafloor.

This modelling yields a gas flow rate commencing at circa 290 MMscf/d with associated condensate at 13 bbl/MMscf yielding a condensate volume of circa 3770 bbl on the first day of the release. The pressure in the reservoir depletes over the period of time taken to control the well (86 days) with an associated decline in gas and condensate rates decline leading to an estimated total released condensate volume of circa 222 thousand barrels. This gives an average release rate for condensate of 2,584 bbl/day over the 86-day period.

Beach has a high degree of confidence in the estimated release rates as they are based on known reservoir properties in the region from both a flow dynamic viewpoint and the composition of the reservoir fluids. Release rates and volumes are based on a total loss of well control which assumes the failure of multiple control systems.

A detailed environmental impact and risk assessment associated with this hypothetical scenario is provided in section 7.18.

Scenario 2: a 300 m^3 surface release of marine diesel oil (MDO) over 6 hours.

This scenario represents a loss of inventory from the largest fuel tank on a project support vessel due to a hypothetical vessel collision incident at the Artisan-1 well location. The calculation of discharge volume and timing aligns with the methodology recommended in the AMSA Technical guidelines for preparing contingency plans for marine and coastal facilities (Commonwealth of Australia, January 2015). A detailed environmental impact and risk assessment associated with this hypothetical scenario is provided in section 7.18.

7.16.1 Hydrocarbon exposure thresholds

In the event of an oil pollution incident, the environment may be affected in several ways, depending on the concentration and duration of exposure of the environment to hydrocarbons. The hydrocarbon exposure thresholds presented in Table 7-4 are considered appropriate to:

- predict potential hydrocarbon contact at conservative (low exposure) concentrations and inform the description of the environment (Section 5), inform the EPBC Protected Matters Search (Appendix A) and identify the Australian Marine Parks (AMP), Marine National Parks (MNP), Marine Parks (MP), and RAMSAR wetlands that may require monitoring in the event of a worst-case discharge based upon conservative (low exposure) in-water thresholds (Table 8-6 and Table 8-7);
- inform the oil spill impact and risk evaluation (Sections 7.17 and 7.18); and

- inform oil spill response planning based upon potentially actionable concentrations of hydrocarbons (see OPEP) and potential monitoring requirements (see Section 8.16.1 and OSMP).

Table 7-10: Hydrocarbon exposure thresholds

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

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

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

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

The spill modelling was performed using an advanced three-dimensional trajectory and fates model, SIMAP (Spill Impact Mapping Analysis Program). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

The modelling study was carried out in several stages. Firstly, a five-year current dataset (2008–2012) that includes the combined influence of ocean currents from the HYCOM model and tidal currents from the HYDROMAP model was developed. Secondly, high-resolution local winds from the Climate Forecast System Reanalysis (CFSR) model and detailed hydrocarbon characteristics were used as inputs in the three-dimensional oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilled oils.

As spills can occur during any set of wind and current conditions, modelling was conducted using a stochastic (random or non-deterministic) approach, which involved running 100 spill simulations per season for each scenario initiated at random start times, using the same release information (spill volume, duration and composition of the oil). This ensured that each simulation was subject to different wind and current conditions and, in turn, movement and weathering of the oil.

7.17 Vessel operations: loss of containment – marine diesel

7.17.1 Hazards

Marine diesel oil is used in offshore vessels. During drilling activities, an accidental release of fuel may occur from a collision between a Beach contracted vessel and third-party vessel. Marine diesel oil is also used for power generation in the MODU and project support vessels. The following events have the potential to result in a spill of fuel:

- a collision between a project support vessel and the MODU or third-party vessel.
- MODU refuelling incident.

A vessel collision typically occurs as a result of:

- mechanical failure/loss of DP
- navigational error, or
- foundering due to weather.

Grounding is not considered credible due to the water depths (approximately 70 m) and absence of submerged features in the operational area.

As detailed in Section 5.8.4 Shipping the majority of commercial shipping traffic transiting to and from Victorian ports, and hence likely to transit through the operational area, in 2018 – 2019 were bulk liquid carriers (696,261), bulk gas (445,230),other cargo (3,800), container (1,057), general cargo (716), car carrier (384) and livestock (36). These shipping vessels would be equipped with AIS and as the MODU and support vessels will have AIS the shipping vessels would be able to identify and avoid the MODU and support vessels. These shipping vessels have enough manoeuvrability to be able to move around the MODU and any support vessels.

7.17.1.1 Characteristics of diesel oils

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

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

Marine diesel is a medium-grade oil (classified as a Group II oil) used in the maritime industry. It has a low density, a low pour point and a low dynamic viscosity (Table 7-11), indicating that this oil will spread quickly when spilled at sea and thin out to low thicknesses, increasing the rate of evaporation.

Due to its chemical composition, approximately 40% will generally evaporate within the first day, with the remaining volatiles evaporating over 3-4 days depending upon the prevailing conditions. Diesel shows a strong tendency to entrain into the upper water column in the presence of moderate winds and breaking waves (>12 knots) but floats to the surface when conditions are calm, which delays the evaporation process. Table 7-12 shows the boiling point ranges for the diesel used in the spill modelling.

Table 7-11: Physical characteristics of marine diesel oil

Parameter	Characteristics
Density (kg/m³)	829 at 15°C
API	37.6
Dynamic viscosity (cP)	4.0 at 25°C
Pour point (°C)	-14
Oil category	Group II
Oil persistence classification	Light-persistent oil

Table 7-12: Boiling point ranges of marine diesel oil

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

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

7.17.1.2 Extent of potential hydrocarbon exposure

The extent of possible exposure to hydrocarbons is based upon a hypothetical worst-case 300 m³ surface release of MDO over 6 hours at the Artisan-1 well location with results derived from the Artisan-1 Exploration Well Oil Spill Modelling, RPS 2019 (Appendix B). The extent of potential hydrocarbon exposure at moderate thresholds (including 48-hour time-based in-water dissolved and entrained) for a marine diesel spill scenario is presented in Figure 7-18.

Potential extent of hydrocarbon exposure to Australian Marine Parks

Whilst Apollo AMP could potentially be exposed to moderate (instantaneous) thresholds of entrained hydrocarbons (up to7% summer and 16% winter), spill modelling indicates there in no potential for Apollo AMP to be impacted by moderate or high time-based in-water exposure thresholds.

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

Potential extent of hydrocarbon exposure to surface waters

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

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

Potential extent of hydrocarbon exposure to shorelines

No shoreline contact above the minimum threshold (>10 g/m^2) was predicted for any of the seasons modelled.

Potential extent of in-water dissolved hydrocarbon exposure

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

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

Potential extent of in-water entrained hydrocarbon exposure

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

7.17.2 Known and potential environmental impacts

The known and potential environmental impacts of a diesel spill are:

- change in water quality

As a result of a change in water quality, further impacts may occur, which include:

- injury / mortality to fauna
- change in fauna behaviour
- change in ecosystem dynamics
- changes to the functions, interests or activities of other users

7.17.3 Consequence evaluation

The potential environmental impacts to receptors within the EMBA are discussed in Table 7-13 to Table 7-16.

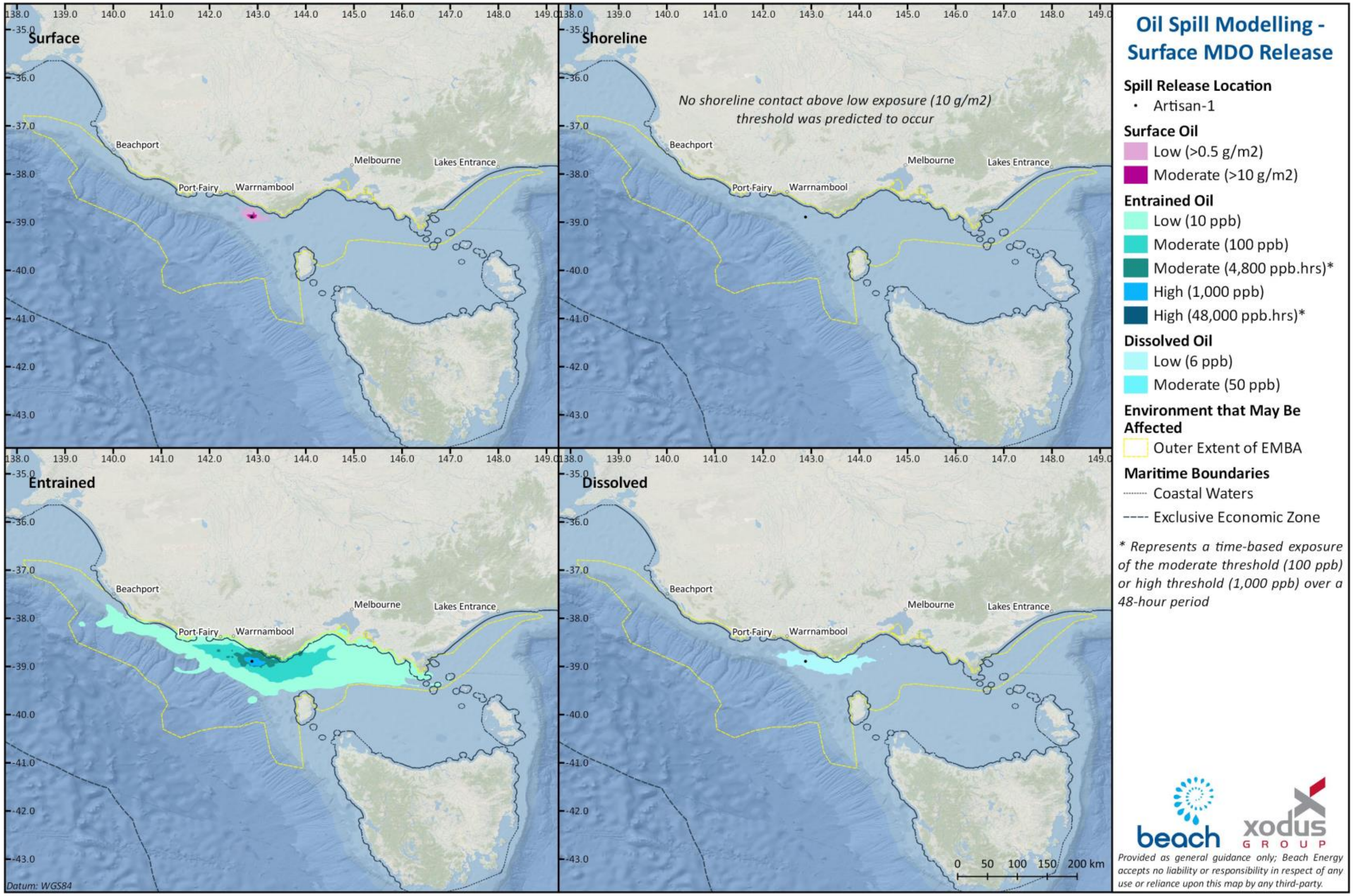

Figure 7-18: Environment potentially exposed to surface and in-water thresholds from a hypothetical 300 m^3 diesel spill at Artisan-1 over 6 hours.

Table 7-13: Consequence evaluation to ecological receptors within the EMBA – sea surface

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Change in fauna behaviour Injury / mortality to fauna	Several listed Threatened, Migratory and/or listed marine species have the potential to be rafting, resting, diving and feeding within 12 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater are present in the area (5.7.7.4) predicted to be above threshold. Foraging and breeding BIAs for little penguins are within the EMBA (Figure 5.21), however are well beyond the predicted area of surface exposure at >10 g/m^2, Colonies of little penguins, without defined BIAs, are known to along parts of Port Campbell Bay area; therefore, it is possible that little penguins may be present in the area exposed to surface hydrocarbon >10g/m^2.	When first released, diesel has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of concentrations >10 g/m^2 out to 12 km from the release location) may be impacted; however, it is unlikely that many birds will be affected as volatile surface hydrocarbons are expected to evaporate over 3-4 days. Seabirds rafting, resting, diving or feeding at sea have the potential to encounter areas where hydrocarbons concentrations are greater than 10 g/m^2 and due to physical oiling may experience lethal surface concentrations. As such, acute or chronic toxicity impacts (death or long-term poor health) to birds are possible but unlikely for a diesel spill because of the limited period of exposure above 10 g/m^2. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, however, impacts to aggregations may occur. Consequently, the potential impacts and risks to seabirds from a loss of MDO containment are considered to be **Serious (3),** as they could be expected to result in localised short-term impacts to formally managed species/habitats of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.17.4.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Marine reptiles	Change in fauna behaviour Injury / mortality to fauna	There may be marine turtles in the area predicted to be exposed to surface oil. However, there are no BIAs or habitat critical to the survival of the species within this area (Section5.7.7.5).	Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing. The number of marine turtles that may be exposed to surface diesel is expected to be low as there are no BIAs or habitat critical to the survival of the species present; however, turtles may be transient within the EMBA. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, with population impacts not anticipated. Consequently, the potential impacts and risks to marine turtles are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.17.4.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Pinnipeds (seals and sea lions)	Change in fauna behaviour Injury / mortality to fauna	The Australian and New Zealand fur-seals may occur within the area predicted to be exposed to surface hydrocarbons >10 g/m^2. No BIAs, breading colonies or haul outs areas are within the area of exposure (Section 5.7.7.7). There is a foraging BIA for the Australian sea-lion but it is outside of the predicted area of surface exposure at >10 g/m^2.	Seals are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water, as they need to surface every few minutes to breathe. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Fur seals are particularly vulnerable to hypothermia from oiling of their fur. The number of seals that may be exposed to surface diesel at >10 g/m^2 is expected to be low as there are no BIAs or habitat critical to the survival of the species present; however, seals may be transient in low numbers within areas of potential surface exposure at >10 g/m^2 (Section 5.7.7.7) . Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would be limited to individuals, with population impacts not anticipated. Consequently, the potential impacts and risks to seals are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.17.4.

	Cetaceans (whales)	Change in fauna behaviour Injury / mortality to fauna	Several threatened, migratory and/or listed marine species have the potential to be within the area predicted to be exposed to surface hydrocarbons of >10 g/m^2. Surface exposure of >10 g/m^2 is expected to extend out 12 km from the release location i.e., a relatively small areas compared to the overall distribution area of cetaceans. Pygmy blue whale foraging BIA and southern right whale current core coastal range are within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (Section5.7.7.6).	Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may displace individuals from important habitat, such as foraging. If whales are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Also, the area exposed by moderate levels of surface hydrocarbons (12 km from the release location) is relatively small compared to the overall distribution area of cetaceans. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and southern right whales current core coastal range, the risk of displacement to whales is considered low. There is potential for interaction with southern right whales given the drilling activity may overlap the northern migration period of May-June, the peak breeding (July-August) or southern migration period (September-November) (Section 5.7.7.6). The proposed drilling timing overlaps with the blue whale season for migration and foraging in the operational area and EMBA. Visual and acoustic surveys suggest that blue whales are present in the Otway region between January and April, peaking in February and March (Section 5.7.7.6). There is no population estimate for blue whales globally or in Australia and they are EPBC listed as endangered and migratory. Blue whales are highly mobile and widespread across the world's oceans. Aerial surveys in the Otway region recorded mean Blue whale group size of 1.3±0.6 per sighting with cow-calf pairs observed in 2.5% of the sightings (Gill et al. 2011).

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				However, acknowledging there is scientific uncertainty with specific whale numbers within the vicinity of the Artisan-1 well location, and given drilling is scheduled during upwelling events, it is expected that foraging whales would be present in the area. As such in the event of a spill potential hydrocarbon exposure could possibly affect aggregations of blue or other foraging whale species. Consequently, the potential impacts and risks to cetaceans are considered to be **Serious (3)** as they could be expected to result in short-term impacts to formally managed species/habitats of recognised conservation value and local ecosystem functioning associated with seasonal upwelling events within the Otway region. Refer to management advice and evaluation of acceptability in Section 7.17.4.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Cetaceans (dolphins)	Change in fauna behaviour Injury / mortality to fauna	There may be dolphins in the area predicted to be exposed to surface oil (>10 g/m^2 - 12 km from the release location). However, there are no BIAs or habitat critical to the survival of the species (Section 5.7.7.6).	Dolphins surface to breathe air and may inhale hydrocarbon vapours or be directly exposed to dermal contact with surface hydrocarbons. Direct contact with oil can result in direct impacts to the animal, due to toxic effects if ingested, damage to lungs when inhaled at the surface, and damage to the skin and associated functions such as thermoregulation (AMSA 2010). Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low. If dolphins are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however due to the short duration of the surface exposure above the impact threshold (approximately 36 hours), this is not likely. Consequently, the potential impacts and risks to dolphins from a loss of MDO containment are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.17.4.

Table 7-14: Consequence evaluation to socio-economic receptors within the EMBA – sea surface

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Human systems	Recreation and tourism (including recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in impacts to marine-based tourism from reduced visual aesthetic. The modelling predicts (visible surface rainbow sheen) surface sheens (0.5 g/m^2) may occur up to 93 km from the release location. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as **Moderate (2).** Refer also to: Cetaceans (whales) Refer to management advice and evaluation of acceptability in Section 7.17.4.
	Industry (shipping)	Displacement of other marine users	Shipping occurs within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (12 km from the release location).	Vessels may be present in the area where sea surface oil is present, however, due to the short duration of the surface exposure (approximately 36 hours) deviation of shipping traffic would be unlikely.
	Industry (oil and gas)	Displacement of other marine users	There are no oil and gas operations or activities within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (12 km from the release location).	No impact as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.

Table 7-15: Consequence evaluation to physical and ecological receptors within the EMBA – in water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Habitat	Algae	Change in habitat	Macroalgae communities may be within the overall area potentially exposed to moderate levels of in-water entrained hydrocarbons. Video surveys confirmed the presence of high density macroalgae dominated epibenthos in waters shallower than 20 m, however, it is not a dominant habitat feature in eastern Victoria (Section 5.7.1.3). Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO residue.	Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer 1971; Cintron et al. 1981). The effect of hydrocarbons however is largely dependent on the degree of direct exposure, and the presence of morphological features (e.g. a mucilage layer and/or fine 'hairs') will directly influence the amount of hydrocarbon that will adhere to the algae. Generally, the effects of oil on macroalgae, such as kelp and many other species which dominate hard substrata in shallow waters is small due to their mucilaginous coating that resists oil absorption. 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. Consequently, the potential impacts to algae are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species/habitats.
	Soft Coral	Change in water quality Change in habitat	Corals do not occur as a dominant habitat type within the EMBA, however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway (Section 5.7.1.4). In-water exposure (entrained) is only predicted to occur within intertidal or shallow nearshore waters. Note that the greater wave action and water column mixing within the nearshore	Exposure of entrained hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate to high exposure thresholds (Shigenaka, 2001). Contact with corals may lead to reduced growth rates, tissue decomposition, and poor resistance and mortality of sections of reef (NOAA, 2010). However, given the lack of coral reef formations, no predicted dissolved in-water hydrocarbon exposure and the sporadic cover of hard or soft corals in mixed nearshore reef communities along the Otway coast, such impacts are considered to be limited to smothering of isolated corals.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			environment will also result in rapid weathering of the hydrocarbon.	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. Consequently, the potential impacts to corals are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species/habitats.
	Seagrass	Change in habitat	In-water exposure (entrained) is only predicted to occur within the surface layers with the potential to contain seagrasses. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO. Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons (e.g. seagrass is known to occur within Twelve Apostles Marine Park) (Section 5.7.1.2). Exposure in nearshore and intertidal areas is predicted to only be at moderate thresholds (e.g. instantaneous exposure >100 ppb for entrained hydrocarbons only).	There is the potential that entrained in-water hydrocarbon exposure could result in sub-lethal impacts from smothering, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984). Given the restricted range of exposure (shallow nearshore and intertidal waters only), no predicted dissolved in-water hydrocarbon exposure and the predicted moderate concentrations of entrained hydrocarbons expected to be in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. Consequently, the potential impacts to seagrass are considered to be **Moderate (2),** as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value.
Marine fauna	Plankton	Injury/Mortality to fauna	Plankton are likely to be exposed to entrained hydrocarbons. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.	Relatively low concentrations of hydrocarbon are toxic to both plankton [including zooplankton and ichthyoplankton (fish eggs and larvae)]. Plankton risk exposure through ingestion, inhalation and dermal contact. Impacts would predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level (Section 5.7.2). Once background water quality conditions have re-established, the plankton community may take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, given the limited area exposed by moderate levels of dissolved hydrocarbons, the potential impacts to plankton are considered to be **Minor (1),** as they could be expected to cause short-term and recoverable impacts.
	Marine invertebrates	Injury/Mortality to fauna	In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not expected. Species located in shallow nearshore or intertidal waters may be exposed to in-water hydrocarbons. Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to	Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g. crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Invertebrates with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year. Tainting of recreation or commercial species is considered unlikely to occur given exposure is limited to entrained hydrocarbons, however if it did it is expected to be localised and low level with recovery expected. Consequently, the potential impacts and risks to commercially fished invertebrates from a loss of MDO containment are considered to be **Minor (1)**, as they could be expected to result

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			moderate levels of entrained in-water hydrocarbons.	in localised short-term impacts to species/habitats of recognised conservation value.
	Fish	Injury/Mortality to fauna	Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, which is not likely to be exposed Section 5.7.7.3). Therefore, any impacts are expected to be highly localised. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the EMBA, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2011a). Subsurface hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. There is the potential for localised and short-term impacts to fish communities; the consequences are ranked as **Moderate (2).** Impacts on fish eggs and larvae entrained in the upper water column are not expected to be significant given the temporary nature of the resulting change in water quality. As egg/larvae dispersal is widely distributed in the upper layers of the water column it is expected that current induced drift will rapidly replace any oil affected populations. Impacts are assessed as temporary and localised, and therefore considered to be **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.17.4.
	Pinnipeds (seals and sea lions)	Injury/Mortality to fauna Change in fauna behaviour	The PMST report identified three pinnipeds that potentially occur in the EMBA (Australian sea lion, Australian and New Zealand fur-seal)	Exposure to moderate effect levels of hydrocarbons in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. However, due to the temporary and localised nature of the spill, their widespread nature, the

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			(Section 5.7.7.7). There are no identified BIAs for seals within the EMBA. Known breeding colonies for Australian fur-seals are on islands off the coast; Kanowna Island, Rag Island, West Moncoeur Island, Lady Julia Percy Island and Seal Rocks (Vic). Cape Bridgewater is also a known haul out site. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. A foraging BIA for the Australian sea-lion is located west and north-west of Beachport within the EMBA. This BIA overlaps both South Australian State waters and the Bonney Coast Upwelling KEF, therefore the predicted hydrocarbon exposure to these areas is likely to also contact with the foraging BIA. There is no predicted exposure to the Bonney Coast Upwelling KEF at the low (48-hour) threshold exposure. A maximum entrained hydrocarbon exposure for a 1-hour window is predicted to be 98 ppb with a 22% probability of low instantaneous exposure to the KEF. There is no predicted dissolved exposure to South Australian State waters and the maximum time entrained hydrocarbon exposure for a 48-hour window is 31 ppb and 26 ppb for a 1-hour window based upon a 2% probability of contact.	low-level exposure zones and rapid loss of the volatile components of diesel in choppy and windy seas (such as that of the area exposed by moderate in-water hydrocarbon thresholds), impacts are assessed as temporary and localised and are considered **Moderate (2**). Refer to management advice and evaluation of acceptability in Section 7.17.4.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			Known breeding colonies of Australian fur-seals are unlikely to be exposed to moderate in-water exposure thresholds, and the foraging BIA for the Australian Sea-lion is not within the predicted area of moderate in-water exposure. Given the mobility of pinnipeds, there may be small numbers of seals and sea-lions in the areas predicted to be temporarily exposed to moderate concentrations of in-water hydrocarbons in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper layers of the water column.	
	Cetaceans (whales and dolphins)	Injury/Mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within an area predicted to be exposed to in-water hydrocarbons. Pygmy blue whale foraging BIA and southern right whale current core coastal range in area exposed to moderate in-water thresholds, i.e. >50 ppb for dissolved and >100 ppb for entrained.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the MDO weathers. The potential for impacts to cetaceans and dolphins would be limited to a relatively short period following the release and would need to coincide with seasonal foraging or aggregation event to result in exposure to a large number of individuals, as may be the case during seasonal upwelling events within the Otway region. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and southern right whales current core coastal range, the risk of

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				displacement to whales is considered low. Displacement behaviours could result in temporary and localised consequences, which are ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.17.4.

Table 7-16: Consequence evaluation to socio-economic receptors within the EMBA – in water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Human system	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to entrained diesel may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the EMBA and overlap the spatial extent of the water column hydrocarbon predictions (Section 5.8.7, 5.8.8 and 5.8.9).).	Any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure are unlikely to manifest at a fish population viability level. Any exclusion zone established would be limited to the immediate vicinity of the release point, and due to the rapid weathering of diesel would only be in place 1-3 days after release, therefore physical displacement to vessels is unlikely to be a significant impact. The consequence to commercial and recreational fisheries is assessed as localised and short term and ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.17.4
	Recreation and tourism	Change in ecosystem dynamics	Tourism and recreation are also linked to the presence of marine fauna (e.g. whales), particular habitats and locations	Any impact to receptors that provide nature-based tourism features (e.g. whales) may cause a

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
		Changes to the functions, interests or activities of other users Change in aesthetic value Change in water quality	for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds can result in indirect impacts to recreational values. It is important to note that the impact from a public perception perspective may be even more conservative. This may deter tourists and locals from undertaking recreational activities. If this occurs, the attraction is temporarily closed, economic losses to the business are likely to eventuate. The extent of these losses would be dependent on how long the attraction remains closed.	subsequent negative impact to recreation and tourism activities. Refer also to: Fish Birds Pinnipeds Cetaceans (whales and dolphins) Marine invertebrates Recreational fisheries Any impact to receptors that provide nature-based tourism features (e.g. fish and cetaceans) may cause a subsequent negative impact to recreation and tourism activities. However, the relatively short duration, and distance from shore means there may be short-term and localised consequences, which are ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.17.4
Natural system	State Marine Protected Areas	Change in ecosystem dynamics Change in aesthetic value Change in water quality	State marine protected areas (e.g. Twelve Apostles Marine Park) occur within the area predicted to be exposed to in-water hydrocarbons at the instantaneous screening level of 100 ppb (entrained). Conservation values for these areas include high marine fauna and flora diversity, including fish and invertebrate	Refer to: Marine invertebrates Macroalgae The consequence to conservation values within the Twelve Apostles Marine Park is assessed as localised and short term and ranked as **Moderate (2).**

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			assemblages and benthic coverage (sponges, macroalgae).	Refer to management advice and evaluation of acceptability in Section 7.17.4.
	Australian Marine Parks	Change in ecosystem dynamics Change in aesthetic value Change in water quality	Stochastic modelling indicates in-water hydrocarbons at the instantaneous screening level of 100 ppb (entrained) may extend to within the boundaries of the Apollo Marine Park (Section 5.5.1). Conservation values for Apollo Marine Park include foraging habitat for seabirds, dolphins, seals and white sharks, and blue whales migrate through Bass Strait. A reduction in water quality will lead to a breach in management objectives for AMPs.	Refer to: Seabirds Cetaceans and pinnipeds) Fish Plankton The concentration at which the water column within Apollo Marine Park may be exposed is within the moderate thresholds for entrained hydrocarbons. Given the nature of the exposure to foraging habitats, and transient nature of migrating and foraging marine fauna, the consequence is ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.17.4.
Conservation Values and sensitivities	Key Ecological Features	Change in water quality Injury / mortality to fauna Change in fauna behaviour. Change in ecosystem dynamics.	The KEFs that overlap the spill EMBA are described in Section 5.5.11, however, the Bonney Coast Upwelling KEF is the only KEF predicted to be exposed to in-water hydrocarbons from a potential MDO spill. MDO is classified as a light persistent oil, has a low specific gravity (and will therefore tend to remain afloat) and has a high proportion (~95%) of volatile components and only a small (5%) residual component. Due to this volatility most of this oil will evaporate from the water surface; depending on wind conditions the proportion of evaporated	Stochastic modelling indicates potential low-level and very short-term hydrocarbon exposure to the Bonney Coast Upwelling KEF resulting in a low-level reduction in water quality. This contact is predicted to be below the conservative environmental impact threshold for pelagic species i.e., moderate thresholds (refer Section 7.16.1 and Appendix B). At the low instantaneous entrained exposure thresholds predicted, there is potential for chronic-level exposure to juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes (see Appendix B).

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			oil may vary between approximately 40% within the first day, with the remaining volatiles evaporating over 3-4 days depending upon the prevailing conditions. Under moderate winds, oil will begin to entrain into the water column. Entrained oil can persist for extended periods of time, however if it refloats it is subject to evaporation and is also subject to dissolution and natural degradation within the water column. There is no predicted dissolved hydrocarbon exposure to any KEF from an MDO spill. The maximum entrained hydrocarbon exposure for a 1-hour window is predicted to be 98 ppb at the Bonney Coast Upwelling KEF with a 22% probability of low instantaneous exposure.	Given the seasonal upwelling event supports regionally high productivity and high species diversity along the Bonney coast extending between Cape Jaffa, South Australia and Portland, Victoria. (DoE, 2015a) and the potential exposure is limited to low threshold contact to the eastern boundary of the Bonney Coast Upwelling KEF, some impairment of ecosystem functioning during an upwelling event could occur. Given the details above, the consequence of an accidental release of MDO causing short-term effects including a potential regional decline in water quality during the upwelling season associated with the Bonney Coast Upwelling KEF has been conservatively assessed as **Serious (3).** Refer to management advice and evaluation of acceptability in Section 7.17.4.
	Wetlands	Change in water quality Change in ecosystem dynamics	Marine waters adjacent to the Port Phillip Bay and Bellarine Peninsula Ramsar site may be exposed to maximum time-entrained (for a 48-hour window) of 7 ppb with no exposure at low thresholds, and a maximum instantaneous exposure of 10 ppb with a 1% probability of exposure at low thresholds. No other Wetlands of International importance identified within the EMBA are predicted to be exposed to hydrocarbons from an MDO spill at any threshold. Nationally important wetlands, with a coastal interface, also occur within the	There is predicted low probabilities of low-level in-water hydrocarbon contact with marine waters adjacent to some wetlands (including both internationally important (Ramsar) and national important sites). Specifically, there is potential for a temporary decline in water quality that may impact on the ecological character of the following Ramsar sites: Port Philip Bay (Western shoreline) and Bellarine Peninsula. Wetland habitat can be of particular importance for some species of birds, fish and invertebrates. As such, in addition to direct impacts on wetland

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			EMBA and may be exposed to in-water hydrocarbons above low thresholds.	vegetation communities, oil that reaches wetlands may also affect these fauna utilising wetlands during their life cycle. Refer to other to receptor evaluations for in-water hydrocarbons, including: Seagrass Fish Marine invertebrates At the predicted low exposure levels for dissolved and entrained in-water contact there is unlikely to be lethal ecological impacts on any of the values (receptors) that contribute to the ecological character of wetlands, however, a conservative consequence of **Moderate (2)** has been applied given the cultural significance and International and National Importance of the wetlands (Ramsar-listed wetlands) and there may be moderate effects to some of these receptors in closer proximity to the release location where they may be exposed to moderate in-water hydrocarbon thresholds. Refer to management advice and evaluation of acceptability in Section 7.17.4

7.17.4 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Loss of marine diesel from vessel collision	
ALARP decision context and justification	**ALARP Decision Context: Type B** Vessel have been used for activities within the Otway offshore natural gas development for many years with no major incident. Vessel activities are well regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these events. However, if a diesel spill occurred from a vessel collision this could attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
CM#7: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Service (AHS) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue AUSCOAST warnings. Relevant details in relation to the vessel activity will be provided to the AHS and AMSA and to relevant stakeholders to ensure the presence of the vessel is known in the area. See Section 9.7 (Ongoing Stakeholder Consultation).
	Under the *OPGGS Act 2006* there is provision for ensuring that petroleum activities are carried out in a manner that doesn't interfere with other marine users to a greater extent than is necessary or the reasonable exercise of the rights and performance of the duties of the titleholder. Beach ensures this is achieved by conducting suitable consultation with relevant stakeholders. Consultation with potentially affected fisheries ensures the risk of interaction with these users is limited.
CM#35: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA's MO 91 [Marine Pollution Prevention – oil], a SMPEP or SOPEP (according to class) is required to be developed based upon the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. To prepare for a spill event, the SMPEP/SOPEP details: • response equipment available to control a spill event; • review cycle to ensure that the SMPEP/SOPEP is kept up to date; and • testing requirements, including the frequency and nature of these tests. • in the event of a spill, the SMPEP/SOPEP details: • reporting requirements and a list of authorities to be contacted; • activities to be undertaken to control the discharge of hydrocarbon; and • procedures for coordinating with local officials. Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
CM#36: MO 21: Safety and emergency arrangements	AMSA MO 21 [Safety of navigation and emergency procedures] gives effect to SOLAS regulations dealing with life-saving appliances and

	arrangements, safety of navigation and special measures to enhance maritime safety.
CM#37: MO 30: Prevention of collisions	AMSA MO 30 [Prevention of collisions] requires that onboard navigation, radar equipment, and lighting meets industry standards.
CM#38: MO 31: Vessel surveys and certification	All vessels contracted to Beach will have in date certification in accordance with AMSA MO 31 [Vessel surveys and certification].
CM#39: Navigation and communication aids	The MODU and project support vessels shall be fitted with an automatic identification system (AIS) transceiver.
CM#8: Petroleum safety zone	A 500 m petroleum safety zone will be established around the MODU during the drilling activity.

Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Eliminate or substitute the use of diesel.	Equipment	The use of diesel for fuel for vessels and machinery cannot be eliminated. Substituting for another fuel, i.e. HFO or bunker fuel oil, would have a higher environmental impact than diesel.	No
CM#8: Petroleum safety zone	Procedure	By the MODU controlling access into the 500 m PSZ, including approach directions and speed, the overall benefit in spill prevention is considered reasonable.	Yes
Smaller vessel used to support drilling activities	Equipment	The support vessels for the drilling activity must capable of moving and securing the MODU, therefore it is not feasible to use smaller vessels as support.	No

Consequence rating	Serious (3)
Likelihood of occurrence	Highly Unlikely (2) based upon AMSA Annual Report 2017-18 (serious incident reports)
Residual risk	Medium
Acceptability Assessment	
To meet the principles of ESD	The activities were evaluated as having the potential to result in a **Moderate (2)** consequence thus is not considered as having the potential to result in serious or irreversible environmental damage • The use of vessels to support exploration of the offshore environment is considered to be standard industry practice. • MDO is classified as a light persistent oil, has a low specific gravity (and will therefore tend to remain afloat) and has a high proportion (~95%) of volatile components and only a small (5%) residual component.

	• The actual area of exposure for an individual spill event will be relatively small, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes. • No shoreline contact above the minimum threshold (>10 g/m2) was predicted for any of the seasons modelled. • No exposure is predicted to sediment quality and benthic habitats and communities. • Plankton near the spill source may be at greater risk of impact, however, with rapid weathering expected, this toxicity also decreases therefore the majority of the area exposed to entrained and dissolved oils are expected to be representative of potential sublethal impacts only. • There are foraging BIAs for a number of birds in the EMBA predicted to be above threshold. Breeding BIAs for the Wedge-tailed shearwater and Little Penguin are within the EMBA. However, these species are associated with onshore habitats • Pygmy blue whale foraging BIA and southern right whale current core coastal range exposed to moderate in-water thresholds, i.e. >50 ppb for dissolved and >100 ppb for entrained. However, as highly mobile species, in general it is very unlikely that these animals will be constantly exposed to concentrations of oils in the water column for continuous durations (e.g. >48–96 hours) that would lead to chronic effects. • KEFs associated with seafloor features and/or benthic and demersal fauna and flora are not expected to be impacted by a release of gas condensate. In-water entrained hydrocarbons was only predicted to expose the 0 to 10 m water depth of the Bonney Coast Upwelling KEF in summer and winter and the West Tasmanian Canyons in winter. There is no potential for in-water dissolved hydrocarbon exposure at the instantaneous moderate threshold to occur within any KEF. • State marine protected areas (e.g. Twelve Apostles Marine Park) occur within the area predicted to be exposed to in-water hydrocarbons at the instantaneous screening level of 100 ppb (entrained). • Apollo AMP could potentially be exposed to moderate (instantaneous) thresholds of entrained hydrocarbons (up to 7% summer and 16% winter), spill modelling indicates there is no potential for Apollo AMP to be impacted by moderate or high time-based in-water exposure thresholds.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	No objections or claims have been raised during stakeholder consultation regarding the potential for diesel spills.
Other Requirements	• Activities undertaken during the proposed drilling will adhere to the requirements for Oil Pollution Emergency Plans (OPEPs) under the OPGGS(E)R. • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and the Navigation Act 2012 implements the International Convention for the Prevention of Pollution from Ships (MARPOL).

	• South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013)
	• The following Conservation Advices / Recovery Plans identify pollution as a key threat:
	  o Conservation Advice *Balaenoptera borealis* (sei whale) (TSSC 2015g)
	  o Conservation Advice *Balaenoptera physalus* (fin whale) (TSSC 2015f)
	  o Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution)
	  o Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f) identified as Habitat degradation/ modification (oil pollution)
	  o National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC 2011a)
	  o Conservation Advice for *Sterna nereis nereis* (fairy tern) (DSEWPC, 2011c)
	• The following Conservation Advices / Recovery Plans identify habitats degradation/modification as threat, which may be consequence of accidental release of hydrocarbon:
	  o Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d)
	  o Conservation Advice *Limosa lapponica baueri* (bar-tailed Godwit (western Alaskan)) (TSSC 2016b)
	  o Conservation Advice *Limosa lapponica menzbieri* (bar-tailed Godwit (northern Siberian)) (TSSC 2016a)
	  o Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE 201e)
	• These Conservation Advices and Recovery Plan identify the following conservation actions:
	  o minimise chemical and terrestrial discharge.
	  o ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs.
	  o ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills.
	  o implement measures to reduce adverse impacts of habitat degradation and/or modification; or
	  o no explicit relevant management actions; oil pollution is recognised as a threat.
	• These conservation advices and recovery plan identify the following in regard to accidental release – MDO, activities associated with the operational area will not be conducted in a manner inconsistent with the objectives of the respective zones of the AMPs, and the principles of the IUCN Area Categories applicable to the values of the AMPs.

Monitoring and reporting	Impacts as a result of a hydrocarbon spill will be monitored and reported in accordance with the OSMP.
Acceptability outcome	**Acceptable**

7.18 Drilling: loss of well control – gas condensate

7.18.1 Hazards

During the drilling activity or whilst the well is suspended there is a risk of a loss of well control (LOWC) event as a result of:

- a loss of well integrity resulting from the failure of multiple well control barriers.
- a prolonged and uncontrolled influx of formation fluid into the well bore (a well kick).

7.18.1.1 Characteristics of the condensate

Thylacine condensate has been used as an analogue. It has a low density, a low pour point and a low dynamic viscosity (Table 4-3), indicating that it will spread quickly when spilled at sea and thin out to low thicknesses, increasing the rate of evaporation (refer to Section 4.4 for further details).

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

7.18.1.2 Extent of potential hydrocarbon exposure

The extend of possible exposure to hydrocarbons is based upon a hypothetical worst-case subsea release of 222,224 bbl (2584 bbl/d) of condensate over 86 days from the Artisan-1 well location with results derived from the Artisan-1 Exploration Well Oil Spill Modelling, RPS 2019 (Appendix B). The extent of potential hydrocarbon exposure at moderate thresholds (including 48-hour time-based in-water dissolved and entrained) for a LOWC scenario is presented in Figure 7-19.

Potential extent of hydrocarbon exposure to Australian Marine Parks

Only Apollo AMP is predicted to be exposed to moderate (instantaneous) thresholds of in-water hydrocarbons (up to 30% summer and 39% winter for dissolved; and up to 50% and 48% winter for entrained).

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

Potential extent of hydrocarbon exposure to surface waters

During summer conditions, moderate (10 - 25 g/m^2) exposure to surface hydrocarbons were predicted to travel a maximum distance of 4 km from the release location. Under winter conditions, moderate exposure from surface hydrocarbons extended to a maximum distance of 3 km from the release location. Note, no high exposure was predicted on the sea surface for any of the seasons assessed.

Potential extent of hydrocarbon exposure to shorelines

The probability of contact to any shoreline was 16% and 57% for the summer and winter season, respectively. While the minimum time for visible surface hydrocarbons to reach a shoreline was 3 days and 5 days, respectively.

The maximum volume of hydrocarbons predicted to come ashore was 15 m^3 and 33 m^3, during summer and winter conditions, respectively, while the maximum length of shoreline contacted above the low threshold (10 – 100 g/m^2) was 7.0 km and 11 0 km, respectively. Note, no shoreline loading was predicted for the high threshold (above 1,000 g/m^2).

Cape Otway West Local Government Area was the receptor predicted with the greatest probability of contact above the moderate threshold during summer (15%) and winter (40%). The modelling results during winter conditions demonstrated additional shoreline contact to Moyne, Corangamite, Moonlight head and Childers Cove.

Potential extent of in-water dissolved hydrocarbon exposure

At the depth of 0-10 m, the maximum concentration of dissolved hydrocarbons over the 48-hour window was 30 ppb in summer and 34 ppb in winter, and hence no moderate or high exposure was predicted during either season.

None of the receptors identified within the spill model were exposed to moderate (50 – 400 ppb) or high (>400 ppb) dissolved hydrocarbons (over a 48-hour basis) during the summer or winter season.

Potential extent of in-water entrained hydrocarbon exposure

The maximum entrained hydrocarbon concentrations time-averaged over 48 hours for the summer and winter season was 559 ppb and 569 ppb, respectively. No moderate or high exposure was predicted for any of the receptors identified within the spill model for any of the seasons.

7.18.2 Known and potential environmental risks

Known and potential environmental risks as result of an uncontrolled hydrocarbon release include:

- change in water quality
- injury / mortality to fauna
- change in fauna behaviour
- change in ecosystem dynamics
- changes to the functions, interests or activities of other users

7.18.3 Consequence Evaluation

The potential environmental impacts to receptors within the EMBA from condensate spill are discussed in Table 7-17 to Table 7-21.

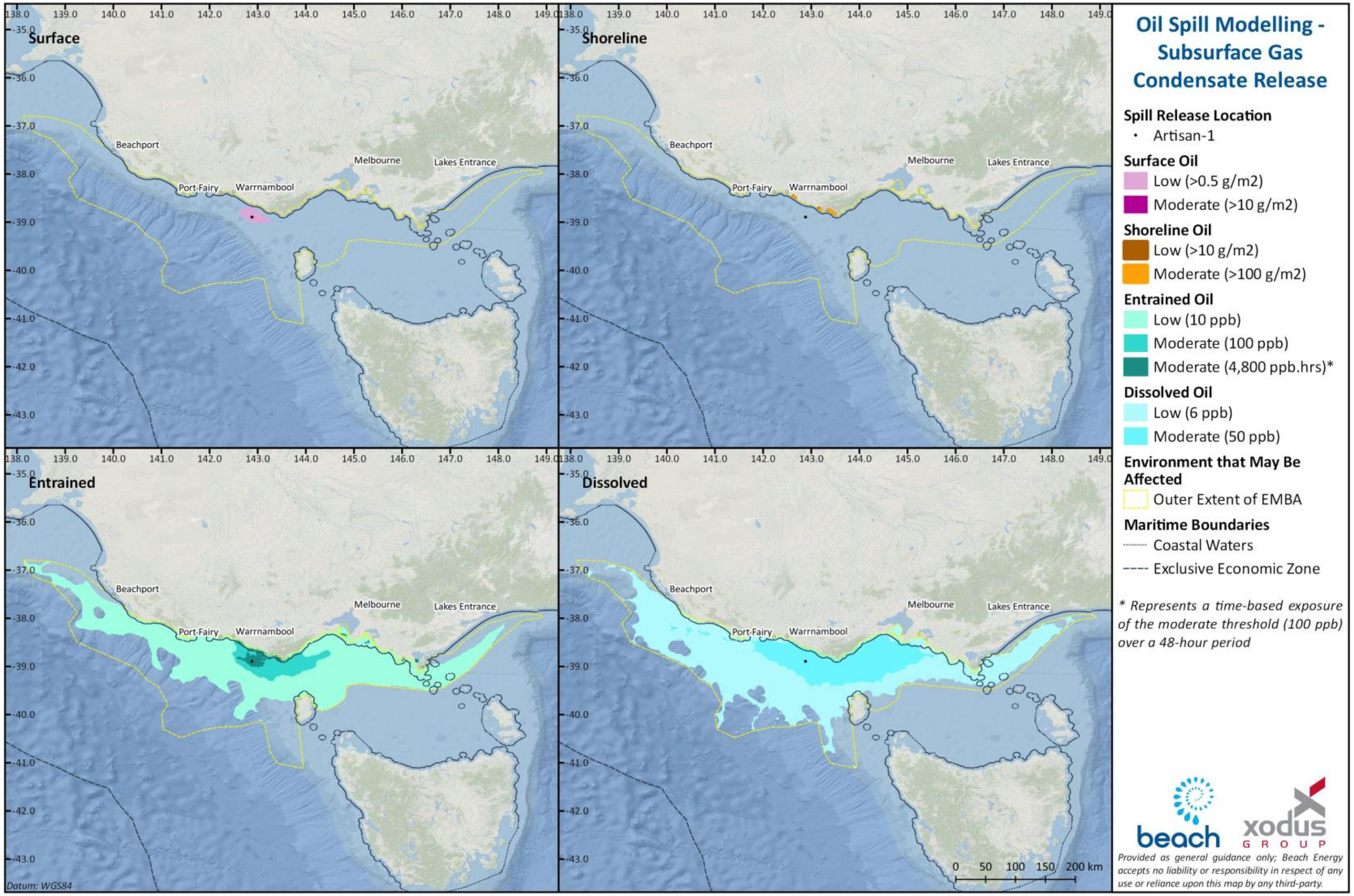

Figure 7-19: Environment potentially exposed to surface, shoreline and in-water thresholds from a hypothetical 222,224 bbl (2584 bbl/d) condensate release from Artisan-1 over 86 days

Table 7-17: Consequence evaluation to ecological receptors within the EMBA – sea surface

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Injury / mortality to fauna Change in fauna behaviour	Several listed Threatened, Migratory and/or Listed Marine species have the potential to be rafting, resting, diving or feeding within 4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater (5.7.7.4) predicted to be above threshold. Foraging and breeding BIAs for little penguins have been identified within the EMBA (Figure 5.21), however are well beyond the predicted area of surface exposure at >10 g/m^2. Colonies of little penguins, without defined BIAs, are known to along parts of Port Campbell Bay area; therefore, it is possible that little penguins may be present in the area exposed to surface hydrocarbon >10g/m^2.	When first released, gas condensate has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of concentrations >10 g/m^2 out to 4 km from the release location) may suffer impacts however it is unlikely that a large number of birds will be affected. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with localised areas of sheen >10 µm and may experience lethal surface thresholds for the duration of the spill. Contact with areas of high hydrocarbon exposure is highly unlikely (i.e. areas of concentrations >25 g/m^2 limited to immediate release location). As such, acute or chronic toxicity impacts (death or long-term poor health) to small numbers of birds may occur. Consequently, the potential impacts and risks to seabirds from a LOWC event are considered to be **Serious (3)**, as they could be expected to result in localised short-term impacts to formally managed species/habitats of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Marine reptiles	Injury / mortality to fauna Change in fauna behaviour	There may be marine turtles in the area predicted to be exposed to surface oil. However, there are no BIAs or habitat critical to the survival of the species within this area (Section 5.7.7.5).	Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				The number of marine turtles that may be exposed to surface diesel is expected to be low as there are no BIAs or habitat critical to the survival of the species present and the localised (4 km from the release location) extent of exposure above the 10 g/m^2 threshold; however, turtles may be transient within the EMBA. Therefore, potential impact would be limited to individuals, with population impacts not anticipated. Consequently, the potential impacts and risks to marine turtles are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	The Australian and New Zealand fur-seals may occur within the area predicted to be exposed to surface hydrocarbons >10 g/m^2. No BIAs, breading colonies or haul outs areas are within the area of exposure (Section 5.7.7.7). There is a foraging BIA for the Australian sea-lion but it is outside of the predicted area of surface exposure at >10 g/m^2.	Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Fur seals are particularly vulnerable to hypothermia from oiling of their fur – however the characteristics of Thylacine condensate mean this is not likely. The number of pinnipeds exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential impacts and risks to pinnipeds from a LOWC event are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Cetaceans (whales)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine species have the potential to be foraging the area predicted to be exposed to surface hydrocarbons of >10 g/m^2. Surface exposure of	Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may displace

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			>10 g/m^2 is expected to extend out 4 km from the release location i.e., a relatively small areas compared to the overall distribution area of cetaceans. Known BIAs are present for foraging for pygmy blue whales and current core coastal range, aggregation, migration and connecting habitat for southern right whale within the EMBA (Section 5.7.7.4).	individuals or aggregations from important habitat, such as foraging. If whales are foraging at the time of the spill, a greater number of individuals may be present in the plume, however due to the small area of the surface exposure above the impact threshold (<4 km from release location), this is not likely. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and southern right whales current core coastal range, the risk of displacement to whales is considered low. There is potential for interaction with southern right whales given drilling activities may overlap with the northern migration period of May-June, peak breeding (July-August) or southern migration period (September-November) (Section 5.7.7.6). The proposed drilling timing overlaps with the blue whale season for migration and foraging in the operational area and EMBA. Visual and acoustic surveys suggest that blue whales are present in the Otway region between January to April, peaking in February and March (Section 5.7.7.6). There is no population estimate for blue whales globally or in Australia and they are EPBC listed as endangered and migratory. Blue whales are highly mobile and widespread across the world's oceans. Aerial surveys in the Otway region recorded mean Blue whale group size of 1.3±0.6 per sighting with cow-calf pairs observed in 2.5% of the sightings (Gill et al. 2011). However, acknowledging there is scientific uncertainty with specific whale numbers within the vicinity of the Artisan-1 well location, and given drilling is scheduled during upwelling events, it is expected that foraging whales would be present in the area. As such in the event of a spill potential hydrocarbon exposure could possibly affect aggregations of blue or other foraging whale species. Consequently, the potential impacts and risks to cetaceans are considered to be **Serious (3)** as they could be expected to result

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				in localised short-term impacts to formally managed species/habitats of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Cetaceans (dolphins)	Injury / mortality to fauna Change in fauna behaviour	There may be dolphins in the area predicted to be exposed to surface hydrocarbons >10 g/m2. However, it is not identified as critical habitat, and there are no spatially defined aggregations (i.e. is not a BIA) in the EMBA (Section 5.7.7.6).	Dolphins surface to breathe air and may inhale hydrocarbon vapours or be directly exposed to dermal contact with surface hydrocarbons. Direct contact with oil can result in direct impacts to the animal, due to toxic effects if ingested, damage to lungs when inhaled at the surface, and damage to the skin and associated functions such as thermoregulation (AMSA 2010). Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential impacts and risks to dolphins from a LOWC event are considered to be **Minor (1),** as they could be expected to result in localised short-term impacts to species of recognised conservation value. Refer to management advice and evaluation of acceptability in Section 7.18.4.

Table 7-18: Consequence evaluation to socio-economic receptors within the EMBA – sea surface

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Human systems	Recreation and tourism (including recreational fisheries)	Changes to the functions, interests or activities of other users Change in aesthetic value	Marine pollution can result in impacts to marine-based tourism from reduced visual aesthetic. The modelling predicts (visible surface rainbow sheen) surface sheens (0.5 g/m^2) may occur up to 53 km from the release location. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as **Moderate (2).** Refer also to: Cetaceans (whales).
	Industry (shipping)	Changes to the functions, interests or activities of other users	Shipping occurs within the area predicted to be exposed to surface hydrocarbons >10 g/m^2.	Vessels may be present in the area where moderate levels of sea surface oil is present, however, due to the short duration of the surface exposure (approximately 12 hours) deviation of shipping traffic would be unlikely.
	Industry (oil and gas)	Changes to the functions, interests or activities of other users	There are no oil and gas platforms, or activities located within the area predicted to be exposed to surface hydrocarbons.	No impact as there are no oil and gas platforms located within the area predicted to be exposed to moderate thresholds of surface hydrocarbons.

Table 7-19: Consequence evaluation to physical receptors within the EMBA – shorelines

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Shoreline	Saltmarsh	Change in habitat Change in ecosystem dynamics	Saltmarsh communities may be within the overall are potentially exposed to hydrocarbons ashore; and is present within estuaries and inlet/riverine systems. Some of the saltmarsh habitat along this coast may be representative of the Subtropical and Temperate Saltmarsh TEC. Shorelines predicted to be exposed by shoreline hydrocarbons >100 g/m^2 include Moyne, Corangamite, Colac Otway, Cape Otway West, Moonlight Head and Childers Cove. Therefore, exposure (with the risk of ecological impact) to known saltmarsh areas along the Otway coast is limited. Oil can enter saltmarsh systems during the tidal cycles, if the estuary/inlet is open to the ocean. Similar to mangroves, this can lead to a patchy distribution of the oil and its effects, because different places within the inlets are at different tidal heights. Oil (in liquid form) will readily adhere to the marshes, coating the stems from tidal height to sediment surface. Heavy oil coating would be expected to be restricted to the outer fringe of thick vegetation, although lighter oils can	Saltmarshes are considered to have a high sensitivity to hydrocarbon exposure. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil. Evidence from case histories and experiments shows that the damage resulting from oiling, and recovery times of oiled marsh vegetation, are very variable. In areas of light to moderate oiling where oil is mainly on perennial vegetation with little penetration of sediment, the shoots of the plants may be killed but recovery can take place from the underground systems. Good recovery commonly occurs within one to two years (IPIECA, 1994). Consequently, the potential impacts and risks to saltmarsh are considered to be **Serious (3),** as they could be expected to result in localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			penetrate deeper, to the limit of tidal influence.	
Marine fauna	Seabirds and shorebirds	Injury / mortality to fauna Change in fauna behaviour	Threatened, migratory and/or listed marine species have the potential to be foraging or breeding within the area predicted to be contacted by >100 g/m^2 shoreline exposure. The largest length of actionable shoreline oil (defined as >10 g/m^2) is predicted to reach up to 11 km. Predicted peak volume ashore of 33 m^3 was estimated during winter. Shorelines predicted to be exposed by shoreline hydrocarbons >100 g/m^2 include Moyne, Corangamite, Colac Otway, Cape Otway West, Moonlight Head and Childers Cove. Foraging and breeding BIAs for little penguins are within the EMBA (Figure 5.21). However, all known breeding BIAs are located outside of the predicted area of shoreline exposure at >100 g/m^2.	Shoreline species may suffer both direct oiling and potential displacement from foraging and nesting sites. Acute or chronic toxicity impacts (death or long-term poor health) to birds is possible. Direct oiling of nesting sites is considered unlikely as hydrocarbon would typically accrue within the upper swash zone, and nests would occur above this level on a beach. However, oiled fauna may track oil into their nests, which may then have subsequent impacts on any eggs present. This would be more of a risk for fauna, such as the little penguin, that have to traverse the intertidal area to reach nesting sites. Whilst there are no known breeding BIAs for the little penguins along the Otway mainland coast, there is breeding colonies known to occur with Port Campbell Bay area – however, these are outside of the length of shoreline predicted to be exposed to shoreline oil accumulation of >100 g/m^2. In addition, given the volatility of the exposed oil smothering of nests is unlikely. Given the potential for sensitive shoreline habitat to be exposed to hydrocarbons above the actionable >100 g/m^2 shoreline exposure thresholds, the length of shoreline that has the potential to be exposed and the peak volume potentially accumulated ashore, the consequence has been ranked as **Serious (3).** Refer to management advice and evaluation of acceptability in Section 7.18.4.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Natural System	Wetlands	Change in water quality Change in ecosystem dynamics	Nationally important wetlands that occur within the length of shoreline that may be impacted by oil accumulation of >100 g/m^2 are Lower Aire River Wetlands (Section 5.5.6.5) and Princetown Wetlands (Section 5.5.6.8). No shoreline contact above the minimum threshold (>10 g/m^2) was predicted at any Ramsar site for either of the seasons modelled.	These nationally important wetlands have continuity with the sea, including saline marsh areas and estuarine environments that support large numbers of water birds. Wetlands are considered to have a high sensitivity to hydrocarbon exposure. Wetland vegetation (which can include saltmarsh and other estuarine plants) typically have a large surface area for oil absorption and their structure traps oil. The degree of impact of oil on wetland vegetation are variable and complex, and can be both acute and chronic, ranging from short-term disruption of plant functioning to mortality. Spills reaching wetlands during the growing season will have a more severe impact than if oil reaches wetlands during the times when many plant species are dormant. Wetland habitat can be of particular importance for some species of birds, fish and invertebrates. As such, in addition to direct impacts on plants, oil that reaches wetlands also affects these fauna utilising wetlands during their life cycle. Refer also to other receptor evaluations for shoreline exposure, including: saltmarsh seabirds and shorebirds Given the potential for sensitive shoreline habitat including saltmarsh to be exposed to hydrocarbons above the actionable >100 g/m^2 shoreline exposure thresholds, the length of shoreline that has the potential to be exposed and the peak volume potentially accumulated ashore, the consequence has been ranked as **Serious (3)** as they could be expected to result in localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.

Table 7-20: Consequence evaluation to physical and ecological receptors within the EMBA – in water

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Habitat	Algae	Change in habitat	In-water exposure (dissolved or entrained) is only predicted to occur within the surface layers; therefore, the only exposure to benthic habitat is possible within intertidal or shallow nearshore waters (Section 5.7.1.3). Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the condensate. Macroalgae may be present within reef and hard substrate areas within the area predicted to be exposed to in-water hydrocarbons (e.g. macroalgae is known to occur within Twelve Apostles Marine Park, and areas around Warrnambool). Noting also that exposure in nearshore and intertidal areas is predicted to only be at moderate thresholds (e.g. instantaneous exposure >50 ppb for dissolved and >100 ppb for entrained hydrocarbons).	Reported toxic responses to oils have included a variety of physiological changes to enzyme systems, photosynthesis, respiration, and nucleic acid synthesis (Lewis & Pryor 2013). A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and only the predicted moderate threshold concentrations of hydrocarbons expected to be in these waters, any impact to macroalgae is not expected to result in long-term or irreversible damage. Consequently, the potential impacts to macroalgae are considered to be **Moderate (2),** as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value.
	Soft Coral	Change in habitat	Corals do not occur as a dominant habitat type within the EMBA, however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway (Section 5.7.1.4).	Exposure of entrained hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate to high exposure thresholds (Shigenaka, 2001). Contact with corals may lead to reduced growth rates, tissue decomposition, and poor resistance and mortality of sections of reef (NOAA, 2010).

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			In-water exposure (dissolved or entrained) is only predicted to occur within the surface layers; therefore, the only exposure to benthic habitat is possible within intertidal or shallow nearshore waters. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the condensate. Corals may be present within reef and hard substrate areas within the area predicted to be to in-water hydrocarbons, noting also that exposure in nearshore and intertidal areas is predicted to only be at moderate thresholds (e.g. instantaneous exposure >50 ppb for dissolved and >100 ppb for entrained hydrocarbons).	However, given the lack of coral reef formations, and the sporadic cover of hard or soft corals in mixed nearshore reef communities along the Otway coast, such impacts are considered to be limited to isolated corals. Consequently, the potential impacts to corals are considered to be **Moderate (2),** as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value.
	Seagrass	Change in habitat	In-water exposure (dissolved or entrained) is only predicted to occur within the surface layers; therefore, benthic habitat within intertidal or shallow nearshore waters has the potential to be exposed. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the condensate. Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons (e.g. seagrass is	There is the potential that exposure could result in sub-lethal impacts, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984). Exposure also can take place via uptake of hydrocarbons through plant membranes and seeds may be affected by contact with oil contained within sediments (NRDA 2012). When seagrass leaves are exposed to petroleum oil, sub-lethal quantities of the soluble fraction can be incorporated into the tissue, causing a reduction in tolerance to other stress factors (Zieman et al. 1984). The toxic components of petroleum oils are thought to be the PAH, which are lipophilic and therefore able to pass through lipid membranes and tend to accumulate in the thylakoid

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			known to occur within Twelve Apostles Marine Park, and areas around Warrnambool) (Section 5.7.1.2). Exposure in nearshore and intertidal areas is predicted to only be at moderate thresholds (e.g. instantaneous exposure >50 ppb for dissolved and >100 ppb for entrained hydrocarbons).	membranes of chloroplasts (Ren et al. 1994). Susceptibility of seagrasses to hydrocarbon spills will depend largely on distribution, with deeper communities protected from oiling under all but the most extreme weather conditions. Shallow seagrasses are more likely to be affected by dispersed oil droplets. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted moderate concentrations of hydrocarbons expected to be in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. Consequently, the potential impacts to seagrass are considered to be **Moderate (2)**, as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value.
	Plankton	Injury / mortality to fauna	Plankton are typically more abundant in surface waters where in-water exposure (dissolved or entrained) is predicted to occur. Potential in-water dissolved hydrocarbon exposure at the instantaneous moderate threshold does occur in the Bonney Coast Upwelling KEF. While hydrocarbon presence would not affect the upwelling itself, if the spill occurs at the time of an upwelling event, it may result in plankton being exposed to low instantaneous concentrations of in-water hydrocarbons. While these levels are not expected to cause lethal effects on the plankton, if this did	Relatively low concentrations of hydrocarbon are toxic to both plankton [including zooplankton and ichthyoplankton (fish eggs and larvae)]. Plankton risk exposure through ingestion, inhalation and dermal contact with in-water hydrocarbons. Impacts would predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web. However, any impact is expected to be localised and temporary, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Once background water quality conditions have re-established, the plankton community may take weeks to months to

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			occur there is the potential for flow on effects to whales or other marine fauna that use this as a food source (i.e. reduced prey availability).	recover (ITOPF, 2011), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, the potential impacts to plankton are considered to be **Moderate (2)**, as they could be expected to cause short-term and localised impacts.
	Marine invertebrates	Injury / mortality to fauna Changes to the functions, interests or activities of other users	The modelling indicates that area predicted to be exposed for dissolved hydrocarbons would predominately be at 0-10 m and 10-20 m water depth, with some patch exposure extending into the 20-30 m water depths. Modelling indicated entrained hydrocarbons to only expose the 0-10 m water depth. 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. Filter-feeding benthic invertebrates such as sponges, bryozoans, abalone and hydroids may be exposed to in-water hydrocarbons at concentrations with the potential for sub-lethal impacts. Tissue taint, if it occurs, may	Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g. crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Invertebrates with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year. Tainting of recreation or commercial species is considered unlikely to occur, however if it did it is expected to be localised and low level with recovery expected. Consequently, the potential impacts and risks to commercially fished invertebrates from a LOWC event are considered to be **Moderate (2)**, as they could be expected to result in localised short-term impacts to species/habitats of recognised conservation value.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			remain for several months in some species (e.g., abalone). In-water invertebrates of value that may be exposed to in nearshore/intertidal waters have been identified to include molluscs (scallops, abalone). Management areas for several commercial fisheries focussed on marine invertebrates are within the area predicted to be exposed to dissolved and entrained in-water hydrocarbons.	
Marine fauna	Fish	Injury / mortality to fauna	In-water exposure (dissolved or entrained) is only predicted to occur within the surface layers of the water column. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, as such, exposure to these species is not expected to occur (Section 5.7.7.3). Any fish or shark species within the surface layers of the water column, may come into contact with the area of predicted exposure for in-water hydrocarbons. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is	Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2010). Subsurface hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. There is the potential for localised and short-term impacts to fish communities; the consequences are ranked as Moderate (2). Impacts on eggs and larvae entrained in the upper water column are not expected to be significant given the temporary period of water quality impairment, and the limited geographical extent of the spill. As egg/larvae dispersal is extensive in the upper layers of the water column and it is expected that current induced drift will rapidly replace any oil affected populations. Impacts are assessed as

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the EMBA, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	temporary and localised, and therefore considered to be **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	The PMST report identified three pinnipeds that potentially occur in the EMBA (Australian sea lion, Australian and New Zealand fur-seal) (Section 5.7.7.7). There are no identified BIAs for seals within the EMBA. Known breeding colonies for Australian fur-seals are on islands off the coast; Kanowna Island, Rag Island, West Moncoeur Island, Lady Julia Percy Island and Seal Rocks (Vic). Cape Bridgewater is also a known haul out site. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. A foraging BIA for the Australian sea-lion is located west and north-west of Beachport within the EMBA (Section 5.7.7.7). The is no predicted moderate in-water exposure to this BIA. Given the mobility of pinnipeds, there may be small numbers of seals and sea-lions in the areas predicted to be temporarily exposed to moderate	Hydrocarbons in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds, however given the localised nature of the spill, their widespread nature, no known breeding colony within the area of predicted ecological exposure (above time-based exposure concentrations), and the rapid loss of the volatile components of condensate in choppy and windy seas (such as that of the area exposed by moderate in-water hydrocarbon thresholds), impacts are assessed as temporary and localised and are considered **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.18.4.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			concentrations of in-water hydrocarbons in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper layers of the water column.	
	Cetaceans (whales and dolphins)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine species have the potential to be migrating, resting or foraging within an area predicted to be exposed to in-water hydrocarbons. Known BIAs are present for foraging for pygmy blue whales and current core coastal range exposed to moderate in-water thresholds, i.e. >50 ppb for dissolved and >100 ppb for entrained (Section 5.7.7.6).	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the condensate weathers There is potential for interaction with southern right whales given the drilling activity may overlap with the northern migration period of May-June, peak breeding (July-August) or southern migration period (September-November) (Section 5.7.7.6). The proposed drilling timing overlaps with the blue whale season for migration and foraging in the operational area and EMBA. Visual and acoustic surveys suggest that blue whales are present in the Otway region between January and April, peaking in February and March (Section 5.7.7.6). There is no population estimate for blue whales globally or in Australia and they are EPBC listed as endangered and migratory. Blue whales are highly mobile and widespread across the world's oceans. Aerial surveys in the Otway region recorded mean blue whale group size of 1.3±0.6 per sighting with cow-calf pairs observed in 2.5% of the sightings (Gill et al. 2011). However, acknowledging there is scientific uncertainty with specific whale numbers within the vicinity of the Artisan-1 well location, and given drilling is scheduled during upwelling events, it is expected that foraging whales would be present in the area. As such in the event of a spill potential hydrocarbon exposure could

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				possibly affect aggregations of blue or other foraging whale species. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and southern right whale current core coastal range, the risk of displacement to whales is considered low. Displacement behaviours could result in temporary and localised consequences to formally managed species, which are ranked as **Serious (3).** Refer to management advice and evaluation of acceptability in Section 7.18.4.

Table 7-21: Consequence evaluation to socio-economic receptors within the EMBA – in water

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Human system	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to in-water hydrocarbons may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the EMBA and overlap the spatial extent of the water	Any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure are unlikely to manifest at a fish population viability level. Any exclusion zone established would be limited to the safety exclusion zone around the vicinity of the release point, and due to the rapid weathering of hydrocarbons would only be in place whilst well-kill activities are enacted, therefore physical displacement to vessels is unlikely to be a significant impact.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			column hydrocarbon predictions (Section 5.8.7, 5.8.8 and 5.8.9).	The consequence to commercial and recreational fisheries is assessed as localised and short term and ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Recreation and tourism	Change in water quality Changes to the functions, interests or activities of other users Change in aesthetic value	Tourism and recreation are linked to the presence of marine fauna (e.g. whales), particular habitats and locations for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds can result in indirect impacts to recreational values. It is important to note that the impact from a public perception perspective may be even more conservative. This may deter tourists and locals from undertaking recreational activities. If this occurs, the attraction is temporarily closed, economic losses to the business are likely to eventuate. The extent of these losses would be dependent on how long the attraction remains closed	Any impact to receptors that provide nature-based tourism features (e.g. whales) may cause a subsequent negative impact to recreation and tourism activities. Refer also to: Fish Birds Pinnipeds Cetaceans (whales and dolphins) Marine invertebrates Recreational fisheries Any impact to receptors that provide nature-based tourism features (e.g. fish and cetaceans) may cause a subsequent negative impact to recreation and tourism activities. However, the relatively short duration, and distance from shore means there may be short-term and localised consequences, which are ranked as **Moderate (2)**.
Natural system	State Marine Protected Areas	Change in ecosystem dynamics	State marine protected areas (e.g. Point Addis and Twelve Apostles Marine Park) occur within the area predicted to be exposed to in-water hydrocarbons.	Refer to: Marine invertebrates Macroalgae

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			Conservation values for these areas include high marine fauna and flora diversity, including fish and invertebrate assemblages and benthic coverage (sponges, macroalgae).	The consequence to conservation values in these protected marine areas is assessed as localised and short term and ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Australian Marine Parks (AMPs)	Change in ecosystem dynamics Change in water quality	Stochastic modelling indicates in-water hydrocarbons at the instantaneous screening level of 50 ppb (dissolved) and 100 ppb (entrained) may extend to within the boundaries of the Apollo AMP. Conservation values for Apollo AMP include foraging habitat for seabirds, dolphins, seals and white sharks, and blue whales migrate through Bass Strait. A reduction in water quality will lead to a breach in management objectives for AMPs.	Refer to: Seabirds Cetaceans and pinnipeds Fish Plankton The concentration at which the water column within Apollo Marine Park may be exposed is within the moderate thresholds for dissolved and entrained hydrocarbons. Given the nature of the exposure to foraging habitats, and transient nature of migrating and foraging marine fauna, the consequence is ranked as **Moderate (2).** Refer to management advice and evaluation of acceptability in Section 7.18.4.
	Key Ecological Features (KEFs)	Change in water quality Injury / mortality to fauna Change in fauna behaviour Change in ecosystem dynamics	The KEFs potentially exposed to in-water hydrocarbons include: • The Bonney Coast Upwelling • Upwelling East of Eden • The West Tasmanian Marine Canyons The West Tasmanian Canyons are located on the relatively narrow and steep continental slope west of Tasmania. Eight submarine canyons surveyed in Tasmania, Australia, by Williams et al., (2009) displayed depth-related patterns with	Stochastic modelling indicates low likelihood potential for low-moderate in-water hydrocarbon exposure to the Bonney Coast Upwelling KEF resulting in a potential reduction in water quality over the duration of a LOWC event (up to 86 days). Instantaneous exposure to moderate levels of dissolved hydrocarbon may have chronic ecological effects on pelagic species (refer Section 7.16.1

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			regard to benthic fauna, in which the percentage occurrence of faunal coverage visible in underwater video peaked at 200-300 m water depth. In-water hydrocarbons were only predicted to expose the 10 to 20 m water depth of the West Tasmanian Canyons. Given peak faunal coverage is at 200 to 300 m water depth it is not predicted to be exposed by in-water hydrocarbons. The maximum <u>dissolved</u> hydrocarbon exposure to the Bonney Coast Upwelling KEF for 48-hour window is 10ppb in summer and 6 ppb in winter with 1 % probability of low exposure over each season. The maximum dissolved instantaneous hydrocarbon exposure over a 1-hour window to the Bonney Coast Upwelling KEF is 97 ppb in summer and 86 bbp in winter with a 2% probably of moderate exposure for both seasons. The Upwelling East of Eden has a 1% probability of instantaneous low dissolved exposure in winter only. The maximum <u>entrained</u> hydrocarbon exposure to the Bonney Coast Upwelling KEF for 48-hour window is 36 ppb in summer and 32 ppb in winter with 1 % probability of low exposure over each season. The maximum entrained instantaneous hydrocarbon exposure over a 1-hour window to the Bonney Coast Upwelling KEF is 53 ppb in summer and 42 bbp in winter with a 72% probably of low exposure in summer and 32% in	and Appendix B), however, this is unlikely given both the instantaneous nature of the exposure and low probability of occurrence. At the low instantaneous entrained exposure thresholds predicted, there is potential for chronic-level exposure to juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes (see Appendix B). Given the seasonal upwelling event supports regionally high productivity and high species diversity along the Bonney Coast extending between Cape Jaffa, South Australia and Portland, Victoria. (DoEE) and the potential exposure is limited to low-moderate threshold contact to the eastern boundary of the Bonney Coast Upwelling KEF, some impairment of ecosystem functioning during an upwelling event could occur. Likewise, at the low-level exposure predicted at the Upwelling East of Eden, some impairment (although unlikely) of ecosystem functioning during an upwelling event could occur. Given the details above, the consequence of an accidental release of Thylacine condensate causing short-term effects including a potential regional decline in water quality during the upwelling season associated with the Bonney Coast or Upwelling East of Eden KEFs has been conservatively assessed as **Serious (3).** Refer to management advice and evaluation of acceptability in Section 7.18.4.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			winter. No moderate exposure is predicted for either season. The Upwelling East of Eden has a 21% probability of instantaneous low entrained exposure in winter only.	
	Wetlands	Change in water quality Change in ecosystem dynamics	No in-water hydrocarbon contact is predicted with Glenelg Estuary, Lavinia or Piccaninnie Ponds Karst Wetlands Ramsar sites for either of the seasons modelled. The maximum dissolved hydrocarbon exposure (over the 48-hour window) at Western Port Ramsar site was predicted to be 1 ppb in summer. The maximum dissolved hydrocarbon exposure (over the 48-hour window) predicted at Western Port and Port Philip Bay and Bellarine Peninsula Ramsar sites was 3 ppb and 1 ppb respectively in winter. The maximum dissolved hydrocarbon exposure (over the 1-hour window) predicted at Western Port and Port Philip Bay and Bellarine Peninsula Ramsar sites was 22 ppb and 14 ppb respectively in winter with a 2% probability of low instantaneous exposure threshold in summer for both sites. The maximum dissolved hydrocarbon exposure (over the 1-hour window) at Western Port Ramsar site was predicted to be 2 ppb with a 2% probability of low instantaneous exposure threshold in summer.	There is predicted low probabilities of low-level in-water hydrocarbon contact with marine waters adjacent to some wetlands (including both internationally important (Ramsar) and national important sites). Specifically, there is potential for a temporary decline in water quality that may impact on the ecological character of the following Ramsar sites: • Corner Inlet • Port Philip Bay (Western shoreline) and Bellarine Peninsula • Western Port Wetland habitat can be of particular importance for some species of birds, fish and invertebrates. As such, in addition to direct impacts on wetland vegetation communities, oil that reaches wetlands may also affect these fauna utilising wetlands during their life cycle. Refer also to receptor evaluations for in-water exposure, including: Seagrass Fish Marine invertebrates

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			The maximum entrained hydrocarbon exposure (over the 48-hour window) at Corner Inlet, Port Philip Bay and Bellarine Peninsula and Western Port Ramsar sites was predicted to be 10 ppb, 19 ppb and 21 ppb respectively in summer and 10 ppb, 18 ppb and 16 ppb respectively in winter. However, no contact at low, medium or high 48-hour window thresholds was predicted at any Ramsar site for either summer or winter. The maximum entrained hydrocarbon exposure (over the 1-hour window) at Corner Inlet, Port Philip Bay and Bellarine Peninsula and Western Port Ramsar sites was predicted to be 11 ppb, 25 ppb and 24 ppb respectively in summer and 12 ppb, 23 ppb and 21 ppb in winter with a respective 10%, 27% and 30% probability of low instantaneous exposure threshold. The was no predicted moderate to high entrained hydrocarbon exposure (either 48-hour or 1-hour window) for any Ramsar site. Nationally important wetlands, with a coastal interface, also occur within the EMBA and may be exposed to in-water hydrocarbons above low thresholds.	At the predicted low exposure levels for dissolved and entrained in-water contact there is unlikely to be lethal ecological impacts on any of the values (receptors) that contribute to the ecological character of the wetlands, however, a conservative consequence of **Moderate (2)** has been applied given the cultural significance and International and National Importance of these wetlands (Ramsar-listed wetlands) and there may be moderate effects to some of these receptors in closer proximity to the release location where they may be exposed to moderate in-water hydrocarbon thresholds. Refer to management advice and evaluation of acceptability in Section 7.18.4.

7.18.4 Control measures ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Loss of well control	
ALARP decision context and justification	**ALARP Decision Context: Type B** Drilling activities are common within the Otway offshore natural gas development for many years with no significant LOWC incident recorded to date. Drilling activities are highly regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these events. However, a LOWC incident would likely attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
Preventative	
CM#7: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Service (AHS) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue AUSCOAST warnings. Relevant details in relation to the drilling activity will be provided to the AHS and AMSA and to relevant stakeholders to ensure the presence of the MODU is known in the area. See Section 9.7 (Ongoing Stakeholder Consultation).
CM#40: Beach Well Engineering and Construction Management System (WECS)	Beach have in place a Well Engineering and Construction Management System (WECS) that ensures Beach well activities are fit for purpose with operational risks managed to a level that is as low as reasonably practicable. It also ensures that changes are made in a controlled manner, that appropriate standards are adhered to, and that a sufficiently resourced and competent organisation is in place.
CM#41 NOPSEMA accepted WOMP	Under Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011, NOPSEMA is required to accept a WOMP to enable well activities to be undertaken. The WOMP details well barriers and the integrity testing that will be in place for the program. Beach's NOPSEMA-accepted WOMP describes the minimum requirements for well barriers during drilling activities.
CM#42 NOPSEMA accepted MODU Safety Case	Under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (OPGGS(S)) set out the requirements for the contents of safety cases. The MODU requires and Australian Safety Case detailing the control in place to prevent a major accident event. The MODU Safety Case: • identifies the hazards and risks • describes how the risks are controlled • describes the safety management system in place to ensure the controls are effectively and consistently applied.
CM#37: MO 30: Prevention of collisions	AMSA MO 30 [Prevention of collisions] requires that onboard navigation, radar equipment, and lighting meets industry standards.
CM#21: Preventative Maintenance System – BOP testing	BOP routinely function and pressure tested in accordance with manufacturer's specifications and in alignment with Drilling Contractors preventative maintenance System.

Response	
CM#41: NOPSEMA accepted WOMP	Under Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011, NOPSEMA is required to accept a WOMP to enable well activities to be undertaken. The WOMP details the controls in place to restore well integrity in the event of a LOWC incident.
CM#43: Source Control Contingency Plan (SCCP) including Relief Well Plan	A SCCP shall be developed consistent with International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (January 2019). Specifically detailing: • the structure and function of the Beach Wells Emergency Team (WET); • a timeline for the effective implementation of source control key events / actions; • a well-specific worst-case discharge (WCD analysis); • casing design; • structural integrity analysis; and • gas plume study.
	A relief well plan shall be developed in line with OGUK guidance to ensure that Beach has considered the response requirements in order to: • reduce the time required to initiate relief well drilling operations in the event of a LOWC • allow the relief well to be completed in the shortest time practicable. The relief well plan includes a detailed schedule with estimated times to: • source, mobilise and position a rig • drill and intercept the well • complete the well kill successfully
CM#43: NOPSEMA accepted OPEP	Under the OPGGS(E)R, NOPSEMA require that the petroleum activity have an accepted Oil Pollution Emergency Plan (OPEP) in place before the activity commences. In the event of a LOWC, the OPEP will be implemented. The Offshore Victoria – Otway Basin OPEP was developed to support all Beach activities within the Otway Basin and includes response arrangements for a worst-case LOWC scenario from a development well. The OPEP also includes Tactical Response Plans (TRPs) for identified protection priority areas within the region.
CM#45: NOPSEMA accepted OSMP	Under the OPGGS(E)R, NOPSEMA require that the Implementation Strategy of the Environment Plan provides for monitoring of an oil pollution emergency. The Beach OSMP details: • operational monitoring to inform response planning; and • scientific monitoring to inform the extent of impacts from hydrocarbon exposure and potential remediation requirements.

Additional controls assessed

Control	Control type	Cost/benefit analysis	Control implemented?
Preventative			
Do not drill the Artisan-1 well	Elimination	Drilling the Artisan-1 forms part of the infill development for the Otway Basin to maintain gas supply to the Otway	No

		Gas Plant. Additionally, the exploratory drilling of Artisan-1 is required to fulfil the commitments under the petroleum title.	
Undertake activity at a different time of year to reduce potential exposure of receptors to hydrocarbons	Substitute	Based upon the probability of exposure to various receptors, and the volatile nature of the gas condensate, there is no discernible benefit to be gained by drilling at a different time of year given the similarity in potential hydrocarbon exposure for both summer and winter seasons	No
CM#40:Petroleum safety zone established around the MODU during the drilling activity.	System	The PSZ for the Artisan-1 well is already in place. The exclusion of vessels from a 500 m radius would not cause significant impact on socio-economic receptors, such as fisheries and shipping. By restricting the potential interactions between vessels and the MODU, the overall benefit in spill prevention is considered reasonable.	Yes
CM#40: Petroleum safety zone controlled access to rig safety exclusion zone	System	By the MODU controlling access into the 500 m PSZ, including approach directions and speed, the overall benefit in spill prevention is considered reasonable.	Yes
Dedicated guard vessel always on location to guard MODU from errant vessels	Equipment	A dedicated guard vessel would incur a cost to the project of approximately $20-30K per day of operation. Given the presence of a support vessel always on location, there is no identified net benefit in contracting an additional dedicated guard vessel.	No
CM#40: Petroleum safety zone - support vessel always on location to guard MODU from errant vessels	System / Equipment	The overall benefit for a project support vessel to maintain guard on a 24-hour basis to prevent an errant vessel from impacting the MODU is considered reasonable.	Yes

Source control			
Alternate MODU on standby	Equipment	Any MODU on location would require an in-force Safety Case to operate in Australian Commonwealth waters. The key benefit would be a reduction in the overall shoreline loading from weathered, residual fractions of the condensate. The predicted maximum length of shoreline potentially impacted by moderate thresholds of hydrocarbon is between 4-8 km, with the average predicted being between 2-4 km. There is no predicted shoreline exposure at high thresholds. Having a MODU on standby would potentially halve the time to implement source control, therefore, the overall potential reduction in exposure to shorelines may halve. Halving the potential loading at moderate threshold would produce a marginal overall environment benefit given the nature of weathered condensate. Having another rig on standby would result in significant additional costs (approx. $800k / day) to the project that that are considered grossly disproportionate to the level of environmental benefit gained given the relatively small level of potential shoreline oiling.	No
Capping Stack System (CCS)	Equipment	Well CCS is designed to stem the hydrocarbon flow prior to permanent plugging of the well. This option requires vertical access over the existing BOP/well. CCS systems have a theoretical deployment limit of 75 m water depth even with the use of offset installation equipment (OIE). Given the shallow water depth of Artisan-1 (approx. 71 m), this response option is not considered feasible to implement for a LOWC scenario (due to the release rates of gas and high likelihood of volatile organic compounds (VOCs) above a lower explosive limit (LEL) of 10% at the deployment site.	No
Dispersant application	Equipment	Chemical dispersants are generally ineffective for gas-condensate hydrocarbon releases. However, dispersants may be effective to reduce VOCs at surface to below LELs. Given	No

	the installation of a capping stack is not a feasible response option for the Artisan-1 well, and a relief well would be offset to the release location, there is no potential benefit with applying subsea dispersants at the Artisan-1 well location.
Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1) (1.5 x 10^{-4} per well drilled based upon exploration (appraisal) drilling normal gas wells drilled to North Sea Standard) ref IOGP Risk Assessment Data Directory Blowout Frequencies September 2019: https://www.iogp.org/bookstore/product/risk-assessment-data-directory-blowout-frequencies/
Residual risk	Low
Acceptability assessment	

To meet the principles of ESD	• The activities were evaluated as having the potential to result in a Serious (3) consequence thus is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
	• Thylacine condensate is classified as a non-persistent oil, has a low specific gravity (and will therefore tend to remain afloat) and a significant proportion (99% total) of volatile components and only a small (<1%) residual component.
	• the actual area of exposure for an individual spill event will be relatively small, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes.
	• exposure (with the risk of ecological impact) to known saltmarsh and mangrove areas along the Otway coast is limited.
	• there are foraging BIAs for a number of birds in the area predicted to be above moderate threshold. There are no breeding BIAs within the area, breeding BIAs are outside of the predicted area of moderate surface exposure.
	• BIAs for southern right whales and pygmy blue whales are within the area at risk of potential exposure to surface, entrained and dissolved oils. However, as highly mobile species, in general it is very unlikely that these animals will be constantly exposed to concentrations of oils in the water column for continuous durations (e.g. >48–96 hours) that would lead to chronic effects.
	• the Apollo Bay Marine Park may be exposed to entrained and dissolved oil.
	• industry standards will be met, including:
	  ○ offshore exploratory drilling for gas field development is considered to be standard industry practice.
	  ○ Beach have a Well Engineering and Construction Management System (WECS) considered to be good practice.
	  ○ Beach align with International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (January 2019).

Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8).

External context	No objections or claims have been raised during stakeholder consultation regarding the potential for a loss of well control incident
Other requirements	• activities undertaken during the operation will adhere to the requirements for EPs and Oil Pollution Emergency Plans (OPEPs) under the OPGGS(E)R. • Offshore Petroleum and Greenhouse Gas Storage Act requires an accepted Well Operations Management Plan (WOMP) in place for all wells, which describes well integrity risk management process and well control measures. • south-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) • the following Conservation Advices / Recovery Plans identify pollution as a key threat: o Conservation Advice *Balaenoptera borealis* (sei whale) (TSSC 2015g) o Conservation Advice *Balaenoptera physalus* (fin whale) (TSSC 2015f) o Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution) o Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f) identified as Habitat degradation/ modification (oil pollution) o National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC 2011a) o Conservation Advice for *Sterna nereis nereis* (fairy tern) (DSEWPC, 2011c) • The following Conservation Advices / Recovery Plans identify habitats degradation/modification as threat, which may be consequence of accidental release of hydrocarbon: o Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) o Conservation Advice *Limosa lapponica baueri* (bar-tailed Godwit (western Alaskan)) (TSSC 2016b) o Conservation Advice *Limosa lapponica menzbieri* (bar-tailed Godwit (northern Siberian)) (TSSC 2016) o Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE 2015e) • These conservation advices and recovery plan identify the following conservation actions: o minimise chemical and terrestrial discharge. o ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. o ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. o implement measures to reduce adverse impacts of habitat degradation and/or modification; or o no explicit relevant management actions; oil pollution is recognised as a threat. Regarding accidental release – gas condensate, activities associated with the drilling activities will not be conducted in a manner inconsistent with the objectives of the respective zones of the AMPs and the principles of the IUCN Area Categories applicable to the values of the AMPs

Monitoring and reporting	Impacts as a result of a hydrocarbon spill will be monitored and reported in accordance with the OSMP.
Acceptability outcome	**Acceptable**

7.19 Oil spill response

This section presents the risk assessment for oil spill response options as required by the OPGGS(E)R.

7.19.1 Response option selection

Not all response options and tactics are appropriate for every oil spill. Different oil types, spill locations, and volumes require different response options and tactics, or a combination of response options and tactics, to form an effective response strategy.

Table 7-22 provides an assessment of the available oil spill response options, their suitability to the potential spill scenarios and their recommended adoption for the identified events.

7.19.2 Hazards

The following activities have been identified for responding to a spill event:

- mobilisation, use and demobilisation of spill response personnel, plant and equipment; and
- handling, treatment and/or relocation of affected fauna (oiled wildlife response).

Response option feasibility, effectiveness, capability needs analysis and capability assessment is detailed in Table 7-22.

Table 7-22: Response option feasibility, effectiveness, ALARP identified risks and capability needs analysis

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
Monitor and Evaluate	Visual – aerial & vessel Satellite Predictive modelling	Gas condensate	Feasible. Effective – Gas condensate expected to spread too thin layers on the sea surface within 1 km of the well location. Monitoring used to inform both response planning and monitoring requirements. Hydrocarbons likely visible on sea surface for duration of LOWC. Visual and satellite operational monitoring implemented during LOWC event. Scientific monitoring implemented to inform extent of impact and remediation requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. All feasible monitoring techniques have been applied and monitoring personnel and equipment are readily available for deployment. Monitoring buoy maintained aboard MODU whilst undertaking drilling activity for deployment. No further benefit gained by having additional monitoring capability. OSMP details the vessels and personnel to implement the appropriate scientific studies.	Yes	Actionable on-water hydrocarbon thresholds limited to immediate vicinity of well site. Up to 8 km of coastline subject to moderate oiling. 1 x plane & observer required and/or 1 x vessel & observer and / or 5 x vessels and OSMP study teams Remote oil spill trajectory modelling (OSTM)	As detailed in OPEP: · tracking buoy aboard MODU whilst drilling · tracking buoys available via AMOSC · fixed wing contract in place · aerial observers available via AMOSC · vessels available for duration of drilling campaign · OSTM contract in place and available via AMOSC · environmental monitoring consultants accessible Implement response as per OPEP and under direction of the State Control Agency (if in State waters) Capability in place and sufficient to implement timely response
	Visual – aerial and vessel	MDO	Effective - MDO rapidly spreads to thin layers on surface waters. Monitoring used to inform both response planning and monitoring requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. Scientific monitoring implemented to inform extent of impact and remediation requirements. Both vessel and aerial monitoring capability in place. Trained aerial observers available via AMOSC Core Group and available for deployment. Vessel and aircraft contracts in place. No further benefit gained by having additional monitoring capability.	Yes		
Source Control	Relief well	Gas condensate	The Otway Fields, including Artisan, are considered remote locations and therefore likely to have an impact on the time taken for a suitable rig to be mobilised to the relief well location. This timeframe has been built into the Oil Spill Modelling and response. Rig broker reports are used to monitor the rig market on a monthly basis and, if required, assist in sourcing and contracting a suitable MODU. The rig broker can be contracted to identify and contract a suitably specified rig (including Australian Safety Case status) within 14 days. Note, a MODU mobilised from the NW Shelf or Singapore is likely to take 35 days. These periods have been factored into the relief well schedule within the well-specific relief well plans. Due to the remote location of the Otway Basin, the available rigs shall be monitored on a monthly basis upon commencement of drilling activities thus ensuring the mobilisation of an alternate rig remains feasible within the assumed timeframe of approximately 35 days (the largest time component of the relief well kill). The ongoing assessment of rig availability shall be conducted with reference to: • rig with a valid Australian Safety Case. • rig with the ability to conduct relief well kill operations. • rig ability to operate in shallow water. • proximity to the Otway Basin. • ability to engage in a mutual aid agreement with the Operator. Once a suitable MODU is identified interface shall be managed via the APPEA 'Memorandum of Understanding: Mutual Assistance' (to which Beach Energy is a signatory) between Beach Energy, Oil Operator, Rig Contractor and the Australian Regulator.	Yes	MODU – with Australian Safety Case Casing, drill pipe and consumables 3 x Support vessels Well control personnel as detailed in SCCP	As detailed in OPEP, SCCP and relief well plan: · access to MODU via APPEA MoU · contracts with Well Control Specialists · relief well mobilisation strategy and schedule · Wells Emergency Team (WET) Implement response as per OPEP, SCCP and relief well plan Capability in place and sufficient to implement timely response

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			Furthermore, rig broker reports shall be used to monitor the rig market on a monthly basis for the duration of drilling activities and, if required, assist in sourcing and contracting a suitable MODU: • The rig broker can be contracted to identify and contract a suitably specified rig (including Australian Safety Case status) within 14 days. This allows sufficient time to engage with other operators as well as drilling contractors to confirm availability of drilling rigs with suitable technical specifications to meet the required engineering well design. • To facilitate timely response, Beach is a signatory to the APPEA Memorandum of Understanding: Mutual Assistance for transfer of drilling rigs between operators in the case of an Emergency. A drilling rig that is not currently in operator, or in transit to the next operating well, will be preferential and result in a reduced period from the 14 days allowed for engaging and selecting suitable rigs. The full 14 days will be required where there are no suitable drilling rigs not currently in operation and the selected drilling rig will be required to safely suspend well operations on its existing well prior to commencing of mobilisation to Beach's location. • A MODU mobilised from the NW Shelf or Singapore is likely to take 35 days. These periods have been factored into the relief well schedule within the well-specific relief well plans. • Rating of well control equipment: Rigs considered shall have equipment rated to at least 10,000 psi to perform the required well kill. • Pump capacity of rig: Suitable to execute the dynamic well kill as per modelling. • Water depth: Rig being considered for relief well drilling must be rated for the minimum water depth of 70 m-100 m. Source control planning has identified all reasonable controls to implement relief well in a timely manner. Beach considers the potential environmental benefit gained by having a pre-positioned alternate MODU on location to be grossly disproportionate given the high financial and logistical support cost associated with having a MODU on standby. All reasonable pre-planning has been undertaken to facilitate the timely initiation of a relief well if required.			
	Capping stack system (CSS)	Gas condensate	To assess the feasibility of CSS deployment Beach engaged Trendsetter Engineering, as the OEM manufacturer of capping stacks, to review various capping stack options for the Otway Basin. The challenge with the Otway Basin is the shallow water (71m) of the Artisan-1 well and the prevailing metocean conditions of the Otway Basin. The feasibility analyses are detailed in the following two studies: • Beach Energy Capping Stack Shallow Water Feasibility Assessment • GER-9002748_BE CS Non-Vertical Study The assessment focused on gaining a thorough understanding of the issues faced with shallow water deployment of a CSS in a shallow water, gas blowout well environment (such as Artisan-1). Trendsetter reviewed available concepts promoted within industry and selected the two most viable deployment concepts for further evaluation with the various CSS. Two (2) alternative offset installation (non-vertical access) methods were applied to four (4) different CSS identified by Beach Energy for potential use on a typical shallow water subsea blowout gas well. The two offset installation methods were: 1. Delmar offset installation method 2. Trendsetter offset installation method The methods are further summarised below. The feasibility analysis has confirmed that due to the technical complexity of deploying a capping stack in shallow waters with a gas plume	N/A	N/A	N/A

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			environment and harsh metocean conditions, a relief well is the preferred means of primary source control for the Artisan-1 well. **Delmar Offset Installation Method** After the review of Delmar offset installation report of the capping stack, one major observation or assumption identified from Delmar's primary installation method was the requirement that the subsea blowout wellhead was left clear, with BOP stack removed previously or not installed at all, so that Delmar's subsea wellhead winches could be established for drawdown operations. For the Delmar method the subsea winch is the primary installation method, with the mudmat winch the secondary drawdown method. The positioning of the capping stack is solely dependent on the use of the drawdown winches. The subsea hook up would need to be made with vessel support from outside the plume diameter, with adequate safety margin, estimated to be at least 335 m. Furthermore, with the Delmar method the vertical control is fully dependent on the positive buoyancy of the system, and successful deployment relies heavily on the precisely calculated buoyancy force of the chained buoys, with only minimum control or adjustable measures to compensate the required vertical lifting of the payloads. If the gas plume impact forecast to the buoys is not within the assumed design, then the buoyancy performance will be outside the calculated parameter range. The main disadvantages that impact the successful installation of the CSS using the Delmar method are thus summarised as: • dependent on success of BOP stack removal and installation of subsea winches. With a less heavy 7" 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8" 15,000 psi capping stack (OSRL and WWCI). • increased time for subsea installation of winches, mudmat installations. • gas plume impact on buoyancy modules needs to be well estimated given vertical control for deployment is dependent purely on the positive buoyancy of the system. • complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable. **Trendsetter Offset Installation Method** The Trendsetter method relies on a series of chained oceangoing barges to assist in lifting and deployment of the CSS and BOP adaptor spool. The barges are used to assist positioning and ensure the anchor handling vessel is maintained in a safe zone away from the gas plume. In addition, two subsea winches, may be deployed on clump weights on the seabed approximately 30 m from the wellhead and used for lowering and guidance of the capping stack over the damaged well. In general, the subsea drawdown system would be recommended with a less heavy 7" 15,000 psi capping stack (Boots and Coots) and also to assist with successful guidance of the CSS assembly. Unlike the Delmar method that uses buoyancy modules, these are not required for the Trendsetter method. Furthermore, the use of the drawdown capability is dependent on the wet weight of the stack and the up-thrust forces from the blowout well. The Trendsetter method does require additional vessels available, and also the successful deployment would be limited in the Otway Basin due to the weather and metocean conditions. The main disadvantages that impact the successful installation of the CSS using the Trendsetter method are thus summarised as: • Gas plume impact on oceangoing barges in exclusion zone above blowout well can impact success of the deployment.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			• Increased tie for subsea installation of winches, likely recommended to ensure successful guidance of the CSS assembly. With a less heavy 7" 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8" 15,000 psi capping stack (OSRL and WWCI). • Complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable. **Summary** Rough sea states (as per prevailing in the Otway Basin), including high waves and longer wave periods, can affect the safe operating limits of CSS deployment. The sea state can negatively impact the ability to safety deploy capping stack using a deck crane or A-frame located on the stern of the deployment vessel. Furthermore, if the vessel is experiencing too much heave due to wave action, the CSS could unintentionally hit the subsea wellhead during deployment causing damage to the equipment itself and to the wellhead. Thus, operating limits of acceptable sea states are required for deployment of the equipment for successful deployed in adverse sea state environments such as the Otway Basin. However, the gas plume environment in shallow water conditions is manifestly different to a deeper water environment due to the exclusion zone above the wellhead preventing vertical installation of the equipment. The feasibility analysis has confirmed that due to the technical complexity of deploying a CSS in shallow waters with a gas plume environment and harsh metocean conditions the use of a capping stack is not operationally suitable for Beach well within the Otway Basin, including the Artisan-1 well Additionally, given the use of a CSS is not operationally suitable for the Artisan-1 well, the debris clearance tooling as part of the SFRT is not required.			
	Right stricken vessel Transfer MDO to secure tank	MDO	Effective – primary response strategy for all spills in accordance with vessel SMPEP/SOPEP. Given AMSA is the Control Agency in the event of a stricken vessel in Commonwealth waters, and their access to NatPlan resources not further controls are considered.	Yes	Project support vessels	Project is serviced by multiple support vessels. Capability available at request of AMSA as Control Agency
Offshore Containment and Recovery	Booms and skimmers	Gas condensate	Not feasible. Actionable surface thickness of 10 g/m^2 is expected in the vicinity of the release location (<1 km) for both seasons and within a response exclusion zone in the event of a LOWC scenario.	N/A	N/A	N/A
		MDO	Not feasible. MDO spreads rapidly to less than 10 g/m^2 and suitable thicknesses for recovery are only present for the first 36 hours for a large offshore spill, and there is insufficient mobilisation time to capture residues. In general, this method only recovers approximately 10-15% of total spill residue, creates significant levels of waste, requires significant manpower and suitable weather conditions (calm) to be deployed.			
Protection and Deflection	Booms and skimmer	Gas condensate	Potentially feasible. Partially effective. The maximum length of actionable shoreline oil is approximately 8 km with initial shoreline contact predicted to occur within 3 days of the release with a maximum loading of 33 m^3 predicted. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational NEBA	Response personnel Booms & skimmers Waste facilities	As detailed in OPEP: · Core responders and equipment available via AMOSC · NRT and NRST available via Control Agency request under NatPlan. · Environmental monitoring providers accessible · Waste contracts in place Tactical Response Plans developed for: · Aire River; · Princetown;

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
						· Port Campbell Bay; and · Curdies Inlet Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response
		MDO	No shoreline contact predicted from an MDO spill from any well location.	N/A	N/A	N/A
Shoreline Clean-up	The active removal and/or treatment of oiled sand and debris	Gas condensate	Feasible. Unlikely to be effective in coastal environments of Cape Otway West. The maximum length of actionable shoreline oil is approximately 8 km with initial shoreline contact predicted to occur within 3 days of the release with a maximum loading of 33 m^3 predicted. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. The nature of condensate means that it is difficult to collect from shorelines and can easily be mobilised into lower layers of sand or saltmarsh as may be case in Cape Otway West. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational NEBA – unlikely to present net benefit	Based up a clean-up rate of 1 m^3 per day per person, a single clean-up team (10 persons) could clean 10 m^3 / day. Based on a waste generation (bulking) factor of 10:1, waste clean-up and recovery could take up to 1 month for a team of 10 people. This assumes that all 33 m^3 of stranded hydrocarbon is both accessible and retrievable. In reality, the total retrievable volume (if any) would be smaller.	As detailed in OPEP: · Core Group responders and equipment available via AMOSC · NRT and NRST available via Control Agency request under NatPlan. · Waste contracts in place Tactical Response Plans developed for: · Aire River; · Princetown; · Port Campbell Bay; and · Curdies Inlet Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response
		MDO	No shoreline contact predicted from a MDO spill.	N/A	N/A	N/A
Oiled Wildlife Response (OWR)	Capture, cleaning and rehabilitation of oiled wildlife.	Gas condensate	Feasible. Effective. At the conservative environmental impact threshold (10 g/m^2) the predicted exposure is limited to the vicinity of the release location (up to 12 km for diesel and 4 km for condensate). No exposure is predicted at the high threshold (25 g/m^2). It is unlikely that wildlife would be oiled within the offshore environment, but some oiling of wildlife may occur along the maximum predicted 8 km length of coast exposed to moderate loading thresholds.	Yes	Personnel Equipment Triage and waste facilities	As detailed in OPEP: · Core Group responders and equipment available via AMOSC · NRT and NRST available via Control Agency request under NatPlan. DELWP are the State agency responsible for responding to wildlife affected by a marine pollution emergency in Victorian waters. DELWP's response to oiled wildlife is undertaken in accordance with the Victorian Wildlife Response Plan for Marine Pollution Emergencies. The Tasmanian Oiled Wildlife Response Plan (WildPlan) is administered by the Resource Management and Conservation Division of the DPIPWE. If an incident occurs in Commonwealth waters which affects wildlife, AMSA may request support from DELWP or DPIPWE to assess and lead a response if required. Both DELWP & DPIPWE have a number of first strike kits as well as access to AMOSC oiled wildlife equipment. Capability in place and sufficient to implement timely response
		MDO	Feasible. Effective. Unlikely to require shoreline oiled wildlife response given no predicted shoreline loading. Potential that individual birds could become oiled in the offshore environment.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
Chemical Dispersant Application	Application of chemical dispersants either surface or subsea	Gas condensate	Feasible. Not recommended for Group I oils such as condensate due to the very low viscosity and high volatility – generally no environmental benefit gained by the application of dispersant on Group I oils. Subsea dispersant injection (SSDI) may reduce volatile organic compounds (VOCs) at sea surface within the response area, therefore creating a safer work environment for responders. Given the use of a CSS is not operationally suitable for the Artisan-1 well, the application of chemical dispersants to reduce surface VOC's is not required.	No	N/A	N/A
		MDO	Feasible. Although "conditional" for Group II oil, the size of potential spill volume and the natural tendency of spreading into very thin films is evidence that dispersant application will be an ineffective response. The dispersant droplets will penetrate through the thin oil layer and cause 'herding' of the oil which creates areas of clear water and should not be mistaken for successful dispersion (see ITOPF – Technical Information Paper No. 4: The Use of Chemical Dispersants to Treat Oil Spills).	No	N/A	N/A

7.19.3 Known and potential environmental impacts

Impacts and risks associated with monitoring and evaluation, source control and protection and deflection response strategies (in responding to a hydrocarbon spill) are similar to those discussed for routine vessel, ROV and MODU operations in Section 7. This section covers detailed impact and risk evaluations for oiled wildlife response, shoreline protection and clean-up and the application of chemical dispersants.

7.19.3.1 Oiled wildlife response

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. AMSA as the Control Agency for a vessel spill in Commonwealth waters will managed any OWR and Beach will only undertake OWR if directed by AMSA. Potential impacts are:

- injury/Mortality of fauna
- change in fauna behaviour

7.19.3.2 Shoreline protection and clean up

Sensitive/protected shoreline habitats may be degraded, or marine fauna and flora and other users of the land may be disturbed due to movement of human responders and removal of oiled material on shorelines. Potential impacts are:

- change in fauna behaviour
- injury/Mortality of fauna
- change in habitat
- changes to the functions, interests or activities of other users

7.19.4 Consequence evaluation

This section assesses the impacts and risks specific to OWR and shoreline clean spill response strategies.

7.19.4.1 Oiled wildlife response

OWR includes pre-emptive techniques such as hazing, capturing and relocating of un-oiled fauna as well as post-oiling techniques such cleaning and rehabilitation. Deliberate disturbance of wildlife from known areas of ecological significance (e.g. resting, feeding, breeding or nesting areas) to limit contact of individuals with hydrocarbons may result in inhibiting these species from accessing preferred habitats or food sources. This approach may also result in additional disturbance/handling stress to the affected species with little benefit as many species tend to display site fidelity and return to the location from which they have been moved.

The incorrect handling of oiled fauna has also the potential to result in increased stress levels which has may result in increased fauna mortality. Although fauna interactions from oiled wildlife response and shoreline clean-up techniques are expected to be limited to the duration of the response, there is the potential that these effects may result in longer term impacts to local populations where a large proportion of the local population may be exposed to oil and subsequently oiled wildlife response.

Oiled wildlife preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Oiled wildlife surveillance and wildlife impact studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).

7.19.4.2 Shoreline protection and clean up

Damage or removal of habitat (such as sand from beaches) from shoreline protection and clean-up techniques may expose shorelines to erosion processes or decrease in fauna and flora. Damage to intertidal shoreline habitats and communities may have indirect effects on ecosystem dynamics through impacts on food chains of the macrofauna communities which they support.

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

The movement of spill response personnel, vehicles and equipment through coastal areas has the potential to disturb or damage artefacts or sites of cultural heritage significance. Adverse effects are expected to be localised to the area of disturbance. For known recognised sites, relocation of artefacts or implementation of exclusion zones may be considered as part of the operational NEBA. There is a potential to affect the internationally significant Ramsar wetlands at localised locations. Shoreline clean up and protection will endeavour to prevent impact to the ecological characteristics of Ramsar sites.

Shoreline protection and Clean up preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Hydrocarbon on shorelines and shoreline sediment impacts studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908)

7.19.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: oil spill response			
ALARP decision context and justification	**ALARP Decision Context: B** The purpose of implementing spill response activities is to reduce the severity of impacts from an oil spill to the environment. However, if the strategies do more harm than good (i.e. they are not having a net environmental benefit) then the spill response is not ALARP.		
Control measures	**Source of good practice control measures**		
All spill response control measures and associated Environmental Performance Outcomes (EPOs) and Environmental Performance Standards (EPSs) are detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).			
All relevant operational and scientific monitoring studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).			
Additional controls assessed			
Control	**Control type**	**Cost/benefit analysis**	**Control implemented?**
Monitor and evaluate: AUVs	Engineering Risk Assessment	This control measure is not expected to provide significant environmental benefit as the Artisan-1 well is in close proximity to shore (32 km), and mobilisation of in-field monitoring, or aerial surveillance may be implemented rapidly via existing contracts.	No
Monitor and evaluate: Night-time monitoring – infrared	Engineering Risk Assessment	Side looking airborne radar, systems are required to be installed on specific aircraft or vessels. The costs of sourcing such vessels/aircraft is approximately $20,000 per day. Infrared may be used to provide aerial monitoring at night-time, however the benefit is minimal given trajectory monitoring (and infield monitoring during daylight hours) will give good operational awareness. In addition to this, satellite imagery may be used at night to provide additional operational awareness.	No
OWR: Pre-positioning of oiled wildlife response resources.	Precautionary approach	Oiled wildlife response equipment containers for first strike activities are positioned in Geelong. Positioning the equipment any closer to the potential spill area is not considered to provide a considerable environmental benefit considering that any visible shoreline contact is not predicted until day 3 of the spill, therefore there is adequate time to deploy equipment positioned in Geelong. Additionally, spill modelling indicates potential	No

		(hypothetical) areas of exposure to hydrocarbons, post-spill operational monitoring would be required to predict actual or likely exposure locations, therefore determining an area to pre-position equipment may be inaccurate pre-spill.	
Shoreline protection and clean up: Tactical Response Plans	Precautionary approach	Identified areas for priority protection have pre-populated tactical response plans to reduce response planning timeframes in the event of potential shoreline exposure. Refer to OPEP for TRPs.	Yes
Chemical Dispersant: Pre-positioning of dispersant and application equipment.	Precautionary approach	No clear benefit identified as stockpiles of dispersant already available in Melbourne and elsewhere in Australia. Application equipment and dispersant can be readily mobilised to site, with no identified restriction on logistics pathways or response timing.	No

Consequence rating	Moderate (2)
Residual impact category	Low
Acceptability assessment	
To meet the principles of ESD	The activities were evaluated as having the potential to result in a Moderate (2) consequence thus is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required. While some response strategies may pose additional risk to sensitive receptors, to not implement response activities may potentially result in greater negative impact to the receiving environment and a longer recovery period. Response activities will be undertaken in accordance with controls which reduce and/or prevent additional risks. The mutual interests of responding and protecting sensitive receptors from further impact due to response activities will be managed using a NEBA during response strategy planning in preparedness arrangements, as well as during a response. Proposed response activities are consistent with industry practice. No impact to KEFS, RAMSAR Wetlands, BIAs or state marine protected areas are expected during spill response.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the SCCP including relief well plan, OPEP, Tactical Response Plans and OSMP.
External context	No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (Control Agencies) will occur and thus there will be ongoing consultation with relevant persons during response operations.

Other requirements	Response has been developed in accordance with: • OPGGS Act; • AMSA Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, 2015); and NOPSEMA (2017). • South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) • The following Conservation Advices / Recovery Plans identify pollution as a key threat: o Conservation Advice *Balaenoptera borealis* (sei whale) (TSSC 2015g) o Conservation Advice *Balaenoptera physalus* (fin whale) (TSSC 2015f) o Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution) o Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f) identified as habitat degradation/ modification (oil pollution) o National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC 2011a) o Conservation Advice for *Sterna nereis nereis* (fairy tern) (DSEWPC, 2011c) • The following Conservation Advices / Recovery Plans identify habitats degradation/modification as threat, which may be consequence of accidental release of hydrocarbon: o Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) o Conservation Advice *Limosa lapponica baueri* (bar-tailed Godwit (western Alaskan) (TSSC 2016b) o Conservation Advice *Limosa lapponica menzbieri* (bar-tailed Godwit (northern Siberian)) (TSSC 2016a) o Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE 2015e) • These Conservation Advices and Recovery Plans identify the following conservation actions: o minimise chemical and terrestrial discharge. o ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. o ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. o implement measures to reduce adverse impacts of habitat degradation and/or modification; or o no explicit relevant management actions; oil pollution is recognised as a threat. In regard to oil spill response, activities associated with the drilling activity will not be conducted in a manner inconsistent with the objectives of the respective zones of the AMPs, and the principles of the IUCN Area Categories applicable to the values of the AMPs.

Monitoring and reporting	Impacts will be monitored in accordance with Section 8.16.
Acceptability outcome	**Acceptable**

7.20 Environmental Performance Outcomes, Standards and Measurement Criteria

Beach uses EPOs, EPSs and measurement criteria to demonstrate it is managing its environmental impacts and risks. Outcomes have been developed for each of the identified environmental impacts and risks and have been based around the key identified controls from the control assessment and are aligned with Beach's HSE Policy (refer Figure 8-1). For each EPO and EPS has been developed in conjunction with measurement criteria. The EPOs, EPSs and measurement criteria for this activity are detailed below.

Table 7-23: Environmental performance outcomes, standards and measurement criteria

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person

EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity.
EPO2: Noise emissions in BIAs will be managed such that any whale, including blue whales, continues to utilise the area without injury, and is not displaced from a foraging area.
EPO3: Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.
EPO4: No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity.
	CM#1: National Light Pollution Guidelines for Wildlife	A Seabird Lighting Management Plan will be developed and implemented as per the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) which will detail:
		• activity lighting.
		• seabird population and behaviour within the light EMBA.
		• risk assessment.
		• mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox and at a minimum will implement:
		  o screens, blinds or window tinting on windows to contain light inside the MODU and support vessels.
		  o outdoor/deck lights when not necessary for human safety or navigation will be turned off.
		  o changes to MODU and vessel lighting that has a cost/benefit.
		• biological and light monitoring and auditing.
		• rescue program for if birds land on the MODU or support vessels including advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover:
		  o handling of birds.
		  o releasing of birds.
		  o reporting to DAWE in the case of protected species.
		The seabird management plan will be developed by an appropriately qualified person who should have qualifications equivalent to:
		• a tertiary qualified ornithologist; or
		• experience as evidenced by peer reviewed publications in the last five years on a relevant topic, or other relevant experience.
			Seabird Lighting Management Plan developed and implemented	Drilling Superintendent
				Vessel Master
				Drilling Contractor

	CM#2: MO 97: Marine Pollution Prevention – Air Pollution	• Very low sulphur fuel oil (VLSFO) (e.g. maximum 0.50% S VLSFO-DM, maximum 0.50% S VLSFO-RM) shall be used in support vessels from 1st January 2020. • Vessels with diesel engines>130 kW must be certified to emission standards (e.g. International Air Pollution Prevention [IAPP]). • Vessels shall implement their Ship Energy Efficiency Management Plan to monitor and reduce air emissions (as appropriate to vessel class).	Bunker receipts Ship Energy Efficiency Management Plan (SEEMP) records Certification documentation	Vessel Master Drilling Contractor
	CM#3: Preventative Maintenance System	• Power generation and propulsion systems on the vessels and MODU will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation. • Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.	PMS records	Vessel Master Drilling Contractor

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#4: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	• Vessels operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with dolphins specifically: o Do not approach a dolphin. o Maintain a distance of 150 m from a dolphin. o If a dolphin approaches the vessel try to maintain the separation distances without changing direction or moving into the path of the animal. • Vessels operators shall adhere to the vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with whales specifically: o Do not approach a whale. o Maintain a distance of 1.2 km from a whale. o If a whale approaches the vessel try to maintain the separation distances without changing direction or moving into the path of the animal. • Helicopters will not fly lower than 1650 ft when within 500 m horizontal distance of a cetacean except when landing or taking off and will not approach a cetacean from head on.	Project induction DAWE cetacean sighting sheets	Vessel Master
	CM#5: Pre-start drilling observations	Pre-start observations will be implemented: • observations by a person who has proven experience in whale observation, distance estimation and reporting will be undertaken for 30 minutes from the MODU to 1 km prior to commencing drilling. If whales are present within the 1 km zone drilling will not commence until they have moved outside the 1 km zone or 30 minutes has lapsed since the last whale sighting within 1 km. • observations by a person who has proven experience in whale observation, distance estimation and reporting will be undertaken for 30 minutes from the MODU to 3 km prior to commencing resupply operations. If whales are present within the 3 km zone resupply will not commence until the whale/s have moved outside the 3 km zone or 30 minutes has lapsed since the last whale sighting within 3 km. • drilling or resupply is unlikely to commence at night, however, in the event that it is required it may only occur if there have been no whales sighted within the corresponding observations zones in the preceding daylight hours.	Daily report DAWE cetacean sighting sheets Observer training records	Drilling Superintendent
	CM#6 Marine mammal observer	A dedicated person who has proven experience in whale observation, distance estimation and reporting will be on the MODU to: • identify whales and behaviours. • direct the vessel to maintain the defined separation distance. • undertake drilling and resupply prestart observations.	Daily report DAWE cetacean sighting sheets Observer training records	Drilling Superintendent

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#12: Anchor buoy monitoring	Anchor buoy DTAC provides position every 12 hours. A helicopter or vessel will transit to site within 48 to initially inspect the buoys if: • DTAC readings are not functional. • Buoys are outside of the 100 m geofenced area for three consecutive DTAC readings. To remediate or recover buoys a suitable vessel will be mobilised within 5 days of initial notification (or within 24 hours if already crewed and operational). If a buoy has parted from the anchor chain, attempts will be made to recover it. If the buoy is not recoverable it will be reported to If the buoy is not recoverable it will be reported to AMSA who will issue a Notice to Mariners.	Online monitoring system with geofence area Anchor buoy monitoring weekly report Incident report Notice to Mariners	Wells Manager Otway Offshore
	CM#13: Anchor buoy inspection	A visual inspection of the anchor buoys will be undertaken at least 6-monthly to ensure they are maintained.	Anchor buoy inspection report	Wells Manager Otway Offshore
	CM#30: Vessel speed restrictions	Vessel speeds within the operational area will be restricted to 10 knots.	Project induction Vessel log	Vessel Master

EPO5: No impact to water quality or sediment quality at a distance > 500 m from the well from planned marine discharges.
EPO6: Seabed and associated biota disturbance will be less than 0.8 km^2 and within the operational area.
	CM#19: Hazardous Materials Risk Assessment Process	• Chemicals that will be or have the potential to be discharged to the marine environment will meet the chemical acceptance criteria as per Section 8.21.
		• Chemicals used as a component of a planned drilling discharge will meet the drilling chemical acceptance criteria as per Section 8.21.2, including:
		  ○ components of water-based drilling fluid (WBDF);
		  ○ components of synthetic-based drill fluid (SBDF);
		  ○ stock barite;
		  ○ cementing products; and
		  ○ hydraulic control fluids.
			Completed and approved chemical assessment
			Register of approved chemicals
				Vessel Master
				Drilling Contractor
				Drill Fluids Specialist

	CM#20: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	• Oil contaminated water shall be treated via a MARPOL (or equivalent) approved oily water separator and only discharge if oil content less than 15 ppm. • Sewage discharged at sea shall be treated via a MARPOL (or equivalent) approved sewage treatment system. • Food waste only discharged when macerated to ≤25 mm and at distance greater than 3 nm from land.	Oil record book MARPOL certification Garbage record book Vessel inspection records	Vessel Master Drilling Contractor
	CM#22: Drill Fluid and Cuttings Management Plan	• No whole SBDF shall be discharged overboard. • Remaining synthetic-based drill fluid shall be contained on board the MODU for use when drilling future wells within the Otway Basin. • When unable to be reconditioned offshore, whole synthetic-based drill fluid shall be transported to shore for reconditioning.	Daily drill reports	Drill Fluids Contractor
		• Discharge tank wash shall not exceed 2% base fluid content.	Daily drill reports	Drill Fluids Contractor

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#23: Solids removal and Control Equipment (SCE)	• SCE shall be used to recondition and recycle SBDF and reduce the residual fluid on cuttings (ROC)% to ≤8% ROC (dry weight) per well section prior to overboard discharge.	Retort test results	Drill Fluids Contractor
		• ROC shall be monitored every 300 m whilst drilling with SBDF or twice daily (whichever comes first).	Retort test records	Drill Fluids Contractor
	CM#24: Cementing procedure	• Detailed cementing procedures shall be developed including provision to mix only enough cement to complete the cementing operation with allowance for loss to formation and the monitoring and reconciliation of used quantities of cement against planned quantities for each cementing operation.	Documented cementing procedure Monitoring and reconciliation records	Cementing Contractor
		• At the end of the drilling activity, excess dry bulk cement shall be used for subsequent drilling activities or returned to shore.	Backloading records	Cementing Contractor
	CM#14: Site survey	Site survey undertaken prior to finalising MODU position and location of mooring equipment, and prior to installing or removing wellhead.	Survey records	Drilling Contractor
	CM#15: API RP 2SK – mooring analysis	A mooring analysis shall be undertaken prior to anchoring.	Documented mooring analysis	Drilling Contractor
	CM#16: ISO 19901-7:2013 – mooring tensioning	Mooring tension monitoring shall be undertaken while the MODU is anchored on location.	Control room logbook	Drilling Contractor
	CM#17: Mooring plan	All mooring equipment shall to be within 2 km operational area of the well. Mooring equipment will not be deployed outside the area that has been surveyed as part of the site survey.	Documented mooring plan	Drilling Contractor
	CM#18: OPGGS Act	Upon well abandonment, all subsea equipment shall be removed from sea floor, with wellheads cut below mudline and retrieved to surface.	Drilling Report	Wells Manager Otway Offshore
		Retrieval of all mooring equipment from the sea floor within 3 months following the drilling campaign	Drilling Report	Wells Manager Otway Offshore
EPO7: Undertake the activity in a manner that will not interfere with other marine users to a greater extent than is necessary for the exercise of right conferred by the titles granted.	CM#7: Ongoing consultation	Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 9 (Stakeholder Consultation)	Notification records. Communication records.	Wells Manager Otway Offshore
	CM#8: Petroleum Safety Zone (PSZ)	A 500 m Petroleum Safety Zone (PSZ) will be established at the well location.	PSZ gazettal	Wells Manager Otway Offshore
	CM#9: Commercial Fisher Operating Protocol	The Commercial Fishers Operating Protocol (Appendix D) shall be implemented with Fishers who have identified they fish in the area of the well locations	Notification records. Communication records.	Wells Manager Otway Offshore
	CM#10: Navigation aids	Anchors equipped with a surface buoy with a navigation light.	Prelay Anchor Field Report	Wells Manager Otway Offshore
	CM#11: AUSCOAST warning	AUSCOAST warning issued by AMSA for anchors equipped with a surface buoy.	AUSCOAST warning	Wells Manager Otway Offshore
	CM#12: Anchor buoy monitoring	See EPO1 to EPO4		
	CM#13: Anchor buoy inspection			
EPO8: No introduction of a known or potential invasive marine species	CM#25: MO 98: Marine pollution – anti-fouling systems	Support vessels shall have a current anti-fouling certificate.	Vessel anti-fouling certificate.	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#26: Australian Ballast Water Management Requirements Version 7	Support vessels shall have a valid Ballast Water Management Plan and ballast water management certificate.	Ballast water records. Vessel Ballast Water Management Plan. Vessel Ballast Water Management certificate.	Vessel Master
		Prior to mobilisation to the first drilling location for the program, Beach shall validate that the MODU complies with the Australian Ballast water Requirements (Rev 7), specifically, ensuring the MODU has: • a valid Ballast Water Management Plan; • a ballast water management certificate: and • a ballast water record system with a minimum of 2 years records retained on board.	Ballast water records Vessel Ballast Water Management Plan. Vessel Ballast Water Management certificate.	Drilling Contractor
		Beach shall validate MODU ballast water has been exchanged outside 12 nm from the nearest land and in water depths greater than 50 m prior to undertaking drilling activities.	Ballast water records	Drilling Contractor
	CM#27: National Biofouling Management Guidance for the Petroleum Production and Exploration Industry	Rental anchors and/or mooring equipment shall be cleaned prior to deployment to field.	In-water equipment checklist.	Wells Manager Otway Offshore
		Support vessels shall have a low-risk rating based on (or equivalent to) the WA Department of Fisheries Biofouling Risk Assessment Tool (in lieu of a Commonwealth or VIC specific tool).	Documented biofouling risk assessment indicating 'low-risk' rating	Vessel Master
	CM#28: Australian Biofouling Management Requirements (Proposed) consistent with International Maritime Organization (IMO) 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species	Prior to arrival at the drilling location, Beach shall validate that the MODU has a biofouling management plan and record book consistent with IMO Biofouling Guidelines.	Biofouling Management Plan Biofouling Record Book	Drilling Contractor
	CM#29: Beach Domestic IMS Biofouling Risk Assessment	Prior to the initial mobilisation into the operational area of any MODU, vessel or submersible equipment, Beach shall undertake a domestic IMS biofouling risk assessment as per Section 8.22 of this EP to: • validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational / project area; • identify the potential IMS risk profile of MODUs, vessels and submersible equipment prior to deployment within the operational / project area; • identification in potentially deficiency of IMS controls prior to entering the operational area; • identification of additional controls to manage IMS risk; and • prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational / project area).	Domestic IMS biofouling risk assessment records	Wells Manager Otway Offshore
EPO9: No unplanned discharge of waste to the marine environment.	CM#31: Compliance with Marine Order 95 (Marine pollution prevention – garbage) 2013.	Waste with potential to be windblown shall be stored in covered containers.	HSE inspection records Garbage record book Incident report	Drilling Contractor Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO10: No spills of chemicals or hydrocarbons to the marine environment.	CM#32: Bunkering procedures	Chemical and hydrocarbon bunkering shall be undertaken in accordance with Drilling Contractor bunkering procedures.	JHA records Bunkering records	Drilling Contractor
	CM#33: Drain management	All overboard discharge points from mud pits, and areas containing potentially hazardous substances locked closed and only open under permit.	Permits issued.	Drilling Contractor
	CM#34: Spill containment	Materials and equipment that have the potential to spill onto the deck or marine environment shall be stored within a contained area.	MODU/vessel inspection.	Drilling Contractor Vessel Master
	CM#35: SMPEP or SOPEP (appropriate to class)	MODU and support vessels shall have a SMPEP (or equivalent appropriate to class) which is: • implemented in the event of a spill to deck or marine environment. • tested as per the MODU/vessel test schedule. • spill response kits shall be available and routinely checked to ensure adequate stock is maintained.	MODU/vessel SMPEP MODU/vessel inspection MODU/vessel exercise schedule	Drilling Contractor Vessel Master
	CM#36: MO 21: Safety and emergency arrangements	• Support vessels shall meet the safety measures and emergency procedures of the AMSA MO 21.	Vessel inspection.	Vessel Master
	CM#37: MO 30: Prevention of collisions.	• Support vessels shall meet the navigation equipment, watchkeeping and radar requirements of the AMSA MO 30.	Vessel inspection.	Vessel Master
	CM#38: MO 31: Vessel surveys and certification.	• Support vessels will meet survey, maintenance and certification of regulated Australian vessels as per AMSA MO 31.	Vessel certification.	Vessel Master
	CM#39: Navigation and communication aids.	• The MODU and support vessels shall be fitted with an automatic identification system (AIS) transceiver enabling the MODU/vessel to receive the data broadcasted by surrounding vessels, such as Maritime Mobile Service Identity (MMSI) number, IMO number, VHF call sign, speed, heading and course over ground. • AIS shall be monitored 24 hours per day.	MODU/vessel inspection	Drilling Contractor Vessel Master
	CM#8: Petroleum Safety Zone (PSZ)	• A 500 m PSZ zone shall be established around the MODU during the drilling activity. • Access into the 500 m PSZ, including approach directions and speed, shall be managed via the MODU. • At least one project support vessel shall be stationed near the MODU at all times to guard the MODU from errant vessels.	PSZ gazettal AMSA NTM Control room records	Wells Manager Otway Offshore Drilling Contractor Drilling Contractor Radio Operator
	CM#40: Beach Internal Well Engineering Construction Management System (WECS)	• The Beach WECS shall be applied to manage operational risks associated with drilling to ALARP; document changes to drilling design and implementation; demonstrate alignment with relevant well design and drilling standards; and track organisational competency for Beach drilling personnel.	WECS records	Wells Manager Otway Offshore
	CM#41: NOPSEMA accepted Well Operations Management Plan	Well integrity shall be maintained in accordance with the NOPSEMA accepted WOMP.	NOPSEMA accepted WOMP in place No LOWC event	Wells Manager Otway Offshore

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#42: NOPSEMA accepted MODU Safety Case	Beach shall validate that a NOPSEMA accepted MODU Safety Case is in place for MODU operations.	NOPSEMA accepted MODU Safety Case in place	Drilling Contractor
	CM#21: Preventative Maintenance System – BOP testing	The BOP shall be routinely function and pressure tested in accordance with manufacturer's specifications and in alignment with Drilling Contractors preventative maintenance system.	BOP maintenance records	Drilling Contractor
EPO11: Undertake oil spill response in a manner that will not result in additional impacts to marine environment, coastal habitat and oiled wildlife.	CM#43: Source Control Contingency Plan (SCCP) inclusive of Relief Well Plan	Emergency response capability to implement an effective well kill operation shall be maintained in accordance with well-specific SCCP inclusive of relief well plan.	Documented SCCP in place and consistent with IOGP Report 594 prior to drilling	Wells Manager Otway Offshore
		The SCCP shall be consistent with the International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (2019), Specifically detailing: • the structure and function of the Beach Wells Emergency Team (WET); • a timeline for the effective implementation of source control key events / actions; • a well-specific worst-case discharge (WCD) analysis; • structural integrity analysis; and • gas plume study.	Documented well-specific relief well plan developed in line with OGUK guidance prior to drilling	Wells Manager Otway Offshore
	CM#44: NOPSEMA accepted Oil Pollution Emergency Plan (OPEP)	Emergency spill response capability shall be maintained in accordance with the OPEP	Outcomes of internal audits and tests demonstrate preparedness.	Senior Crisis, Emergency & Security Advisor
		Implement spill response in accordance with relevant EPOs and EPSs in the NOPSEMA accepted OPEP.	EMT log	Beach EMT
	CM#45: NOPSEMA accepted Operational & scientific monitoring Plan (OSMP)	Operational and scientific monitoring capability shall be maintained in accordance with the OSMP: • a month prior to the commencement of drilling a review of the contracted OSMP provider/s capability will be undertaken by Beach to ensure that the OSMP requirements can be met by the contracted OSMP provider/s. • during drilling the contracted OSMP provider/s will provide a monthly report to show that capability as detailed in the OSMP is maintained. • the contracted OSMP provider/s capability to meet the requirements detailed in the OSMP will be tested prior to commencing drilling.	Outcomes of internal audits and tests demonstrate preparedness.	Senior Crisis, Emergency & Security Advisor

8 Implementation Strategy

Regulation 14 of the OPGGS(E)R requires that the EP must contain an implementation strategy for the activity. Beach is the titleholder, however, the existing Lattice Health, Safety and Environment Management System (HSEMS) will be used for this activity. The Lattice HSEMS is consistent with Beach's Environmental Policy (Figure 8-1).

The Implementation Strategy described in this section provides a summary of the HSEMS and how it will be applied to effectively implement the control measures detailed in this EP. Specifically, it describes:

- the HSEMS;
- environment-specific roles and responsibilities;
- arrangements for monitoring, review and reporting of environmental performance;
- preparedness for emergencies; and
- arrangements for ongoing consultation.

8.1 Health, Safety, Environmental Management System

The activity will be undertaken in accordance with the HSEMS. The HSEMS documents the Environmental Policy, HSE Standards, HSE Directives 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 which best suits the business. The HSEMS is aligned with the requirements of recognised international and national standards including:

- ISO 14001 (Environmental Management);
- OHSAS 18001 (Occupational Health and Safety);
- ISO 31000 (Risk Management); and
- AS 4801 (Occupational Health and Safety Management Systems).

At the core of the HSEMS are 20 performance standards which detail specific performance requirements for the implementation of the HSE Environmental Policy and management of potential HSE impacts and risks (Table 8-1). Integral to each Performance Standard are a series of HSE Management Commitments and Processes including Directives, Procedures and other support documents which provide detailed information on requirements for implementation along with specific responsibilities. At the business level the system is complemented by asset and site procedures and plans such as this EP.

Whilst Beach is the titleholder undertaking the petroleum activity, the drilling contractor maintains operational control of the MODU in accordance with the requirements of the MODU-specific Safety Case as accepted by NOPSEMA and the drilling contractor's Management System.

The application of HSEMS Performance Standards relevant to the drilling activity are described in the following sections.

Table 8-1: HSEMS Performance Standards

No	Standard	No	Standard
1	Leadership and Commitment	11	Management of Change
2	Organisation, Accountability, Responsibility and Authority	12	Facilities Design, Construction and Commissioning – Well Engineering Construction Management System (WECS)
3	Planning, Objectives and Targets	13	Contractors, Suppliers, Partners and Visitors
4	Legal Requirements, Document Control and Information Management	14	Crisis and Emergency Management
5	Personnel, Competence, Training and Behaviours	15	Plant and Equipment
6	Communication, Consultation and Community Involvement	16	Monitoring the Work Environment
7	Hazard and Risk Management	17	Health and Fitness for Work
8	Incident Management	18	Environmental Effects and Management
9	Performance Measurement and Reporting	19	Product Stewardship, Conservation and Waste Management
10	Operations	20	Audits, Assessments and Review

8.2 Leadership and commitment (HSEMS Standard 1)

The leadership and commitment standard states that the Board and Executive Management establish the HSE Policy, set expectations and provide resources for successful implementation of the HSE Policy and HSEMS.

All employees are expected to demonstrate commitment to HSE in all facets of their work. An effective method of showing leadership and commitment is by example. An explicit part of this process is to comply with Directive and Procedures associated with the HSEMS Standards and develop and implement effective HSE plans. These plans are aimed at driving the process of continual improvement in HSE performance.

Demonstratable compliance with this EP is a key commitment for Beach.

Environment Policy

Objective

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

Strategy

To achieve this, Beach will:

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

Application

This policy applies to all personnel associated with Beach activities.

Matt Kay
Managing Director and CEO
December 2019

Figure 8-1: Beach's Environmental Policy

8.3 Organisation, accountability, responsibility and authority (HSEMS Standard 2)

This standard states that for Directors, Managers, Supervisors and employees and contractors at all levels, their accountabilities, roles, responsibilities and authority relating to HSE are clearly defined, documented, communicated and understood.

The Beach Energy CEO has the ultimate responsibility for ensuring that Beach Energy has the appropriate organisation in place to meet the commitments established within this EP. However, the General Manager Well Engineering and Construction has the responsibility and delegated authority to ensure that adequate and appropriate resources are allocated to comply with the HSEMS and this EP.

The roles responsibilities for the implementation, management and review of this EP are detailed in Table 8-2.

Responsibility in the event of an oil pollution emergency is dependent on the response category level. For a Level 1 (MODU or vessel) spill, the Offshore Installation Manager or Vessel Master has the immediate responsibility. Roles and responsibilities for an oil pollution emergency response are clearly described in the OPEP.

The roles and responsibilities for the implementation, management and review for this EP are detailed in Table 8-2.

Table 8-2: Roles and responsibilities

Role	Responsibilities
Chief Executive Officer	Ensure: • Beach has the appropriate organisation in place to be compliant with regulatory and other requirements and this EP. • the HSEMS continues to meet the evolving needs of the organisation.
Wells Manager Otway Offshore	Ensure: • compliance with regulatory and other requirements and this EP. • records associated with the activity are maintained as per Section 8.5.2. • personnel who have specific responsibilities pertaining to the implementation of this EP or Oil Pollution Emergency Plan (OPEP) know their responsibilities and are competent to fulfil their designated role. • environmental impacts and risks associated with the activity have been identified and any new or increased impacts or risks are managed via the Management of Change process detailed in Section 8.12. • incidents are managed and reported as per Section 8.9. • the EP report is submitted to NOPSEMA not more than three months after the anniversary date of the EP acceptance. • 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 Management of Change process detailed in Section 8.12. • oil spill response arrangements for the activity are tested as per Section 8.16.1. • ensure audits and inspections are undertaken in accordance with Section 8.24.1.
Drilling Superintendent	• report any event or incident which may result in a release of contaminant and/or impact upon the environment in relation to the project. • report all incidents to the Wells Manager Otway Offshore. • notify the designated authority of all reportable incidents within the specified time frames. • perform incident investigations.

Role	Responsibilities
Drill Site Manager (DSM) (field based)	• ensure all workers are complying with HSE requirements. • report all incidents to the Drilling Superintendent. • implement and comply with this EP. • provide support for audits and inspections in accordance with Section 8.22.1.
Drill Fluids Specialist	• assess any chemicals that will be discharged offshore as per Section 8.21. • establish and monitor procedural controls for the management and monitoring of Offshore chemical use, monitoring and discharge in alignment with relevant commitments within this EP. • maintain records of all drill fluid chemicals stored and discharged offshore.
Drilling HSE Advisor (Office)	• communicate regulatory and other requirements and the requirements in this EP to persons who have specific responsibilities pertaining to the implementation of this EP or OPEP. • develop the environmental component of the activity induction. • provide support in relation to incident management and reporting as per Section 8.9. • develop the EP environmental performance report. • review and document any new or change to an environmental impact or risk or a change that may impact the EP as per Section 8.12. • provide support to ensure audits and inspections detailed in Section 8.24.1 are undertaken and any actions from non-conformances or improvement suggestions tracked. • review and revise the EP as per the requirements in Section 8.24.2 and 8.24.3. • validate weekly MODU inspections as detailed in Section 8.24.1 are undertaken to ensure ongoing compliance with the EP and all EPOs and EPSs are met for all operations (as per Table 7-17).
Drilling HSE Advisor (field based)	• disseminate environmental component of the environment induction to site personnel • conduct weekly MODU inspections as detailed in Section 8.23.1 to ensure ongoing compliance with the EP and all EPOs and EPSs are met relevant to offshore operations (as per Table 7-17)
Community Relations Manager	• undertake stakeholder consultation for the activity. • record and report to the Activity Manager and Environment Advisor any objections or claims raised by relevant stakeholders. • maintain a stakeholder consultation log.

Operations Manager (OM) (Office) – Drilling Contractor	• ensure all regulatory requirements (Commonwealth & State) are met relating to:
	  ○ the mobilisation of the MODU to the drilling location from either international, national or State waters; and
	  ○ the operation of the MODU whilst on the drilling location.

Offshore Installation Manager (OIM) – Drilling Contractor	• operate the MODU in accordance with all relevant Drilling Contractor procedures. • support Beach in the implementation of this EP, specifically with regards to commitments within this EP relating to the operation of the MODU.
Radio Operator – Drilling Contractor	• maintain communication with other marine users in the area as required • communicate with AHO and AMSA JRRC as per Table 9-3.
HSE Advisor – Drilling Contractor	• ensure HSE issues are communicated via systems such as the daily report and daily pre-start meetings.

Role	Responsibilities
	• ensure emissions and discharges identified in Section 8.10.2 are recorded and provided to Beach on a monthly basis.
Vessel Master	Ensure: • vessel operations are carried out in accordance with regulatory requirements and this EP. • vessel adheres to the distances and vessel management practices for whales and dolphins as per the EPBC Regulations (Part 8). • environmental incidents are reported to the Drilling Superintendent within required timeframes as per Section 8.9 . • oil spill response arrangements are in place and tested as per the vessel's SMPEP or equivalent.
Vessel personnel	• complete project induction. • report hazards and/or incidents via company reporting processed. • stop any task that they believe to be unsafe or will impact on the environment.

8.4 Planning, objectives and targets (HSEMS Standard 3)

This standard recognises that a systematic risk-based approach to the management of HSE is in place as an integral part of business planning, with HSE goals, objectives and targets established and measured. A philosophy of continuous improvement is applied to HSE.

EPOs and EPSs have been established to continually reduce potential environmental impacts and risks to ALARP and an acceptable level. EPOs, EPSs and the measurement criteria by which environmental performance for the activity shall be measured are detailed in Table 7-23.

8.5 Legal requirements, document control and information management (HSEMS Standard 4)

This standard specifies that relevant legal and regulatory requirements and voluntary commitments are identified, documented, made accessible, understood and complied with. Effective HSE document control systems are in place to ensure clarity of company expectations and to facilitate efficient and accurate information management.

8.5.1 Legal requirements

Section 3 of this EP details the legislation applicable to the activity and how it has been applied within this EP.

8.5.2 Document control and information management

In accordance with Regulation 27 of the OPGGS(E)R, documents and records relevant to the EP implementation will be stored and maintained for a period of five years in a way that makes retrieval practicable.

8.6 Personnel, competence, training and behaviours (HSEMS Standard 5)

This standard recognises that employees' competence and appropriate behaviours are critical for the safe control of operations and general company success.

Each employee or contractor with responsibilities pertaining to the implementation of this EP shall have the appropriate competencies to fulfil their designated role.

To ensure that personnel are aware of the EP requirements for the activity all offshore personnel will complete an induction, as a minimum. Records of completion of the induction will be recorded and maintained as per Section 8.5.2. The induction will at a minimum cover:

- description of the environmental sensitivities and conservation values of the operational area and surrounding waters;
- controls to be implemented to ensure impacts and risks are ALARP and of an acceptable level;
- requirement to follow procedures and use risk assessments/ job hazard assessments to identify environmental impacts and risks and appropriate controls;
- requirements for interactions with fishers and/or fishing equipment;
- requirement for responding to and reporting environmental hazards or incidents.
- overview of emergency response and spill management plans; and
- fauna sighting and vessel interaction procedures.

In addition to the activity-specific induction, each employee or contractor with specific responsibilities pertaining to the implementation of this EP shall be made aware of their responsibilities, and the specific control measures required to maintain environmental performance and legislative compliance.

8.7 Communication, consultation and community involvement (HSEMS Standard 6)

This standard specifies that effective, transparent and open communication and consultation with stakeholders is valued and undertaken across the company.

The Offshore Installation Manager (OIM), Drill Site Manager (DSM) and vessel masters have responsibility for ensuring that systems are in place to facilitate the communication of HSE issues this is typically via the daily report and daily pre-start meetings. These pre-start (toolbox meetings) will have an HSE component and any relevant environmental issues will be discussed. All workers that participate in a job must attend a pre-start meeting. These workers must sign attendance at these meetings. Any worker not at the pre-start meeting may not work on that job until suitable training has been undertaken. During these pre-start meetings any worker can identify areas of HSE risk and are encouraged to consider areas where HSE performance can be improved.

Stakeholder consultation specific to the activity is detailed in Section 9.

8.8 Hazard and risk management (HSEMS Standard 7)

This standard specifies that HSE hazards and risks associated with the company's activities are identified, assessed and managed to prevent or reduce the likelihood and consequence of incidents.

Section 6 details the impact and risk assessment undertaken to identify and assess the environmental impacts and risks associated with the activity and the control measures that will be implemented to prevent or reduce the likelihood and consequence of incidents.

Risk management processes associated with environmental hazards are manged in accordance with the Environmental Related Risk Procedure and the Risk Management Directive.

As detailed in Section 8.24.2, Beach will undertake a review of this EP to ensure that any changes to activities, controls, regulatory requirements and information from research, stakeholders, industry bodies or any other sources to inform the EP are assessed using risk management tools nominated. The review will ensure that the environmental impacts and risks of the activity continue to be identified and reduced ALARP and an acceptable level.

Environmental risks and Major Environmental Events are assessed through project HAZID's. These ensure that all risks are identified, and suitable operational barriers are put in place. These also form part of the projects Standard Operating Procedures (SOPs) and Job Hazard Analyses.

If revision of this Environmental Management Plan is trigged though change in risk or controls the revision process shall be managed in accordance with Section 8.12 Management of Change.

8.9 Incident management (HSEMS Standard 8)

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. Incidents shall be managed in accordance with the Incident Management Directive.

Incident reports and corrective actions are managed using the Beach Enterprise Incident Management System.

Notifiable incidents will be reported as detailed in Section 8.9.1.

8.9.1 Incident reporting

Notification and reporting requirements for environmental incidents to external agencies are provided in Table 8-3.

Table 8-3: Regulatory incident reporting

Requirement	Timing	Contact	Responsible Person
Recordable incident As defined within the OPGGS(E)R a recordable environmental incident is a breach of an EPO or EPS in the EP that applies to the activity that is not a recordable incident.			
As a minimum, the written monthly recordable report must include a description of: • all recordable incidents which occurred during the calendar month; • all material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out; • corrective actions taken to avoid or mitigate any adverse environmental impacts of the incident; and • corrective actions that have been taken, or may be taken, to prevent a repeat of similar incidents occurring. Regulation 26B of the OPGGS(E)R requires a recordable incident	Before the 15th day of the following calendar month	• NOPSEMA – submissions@nopsema.gov.au	Drilling HSE Advisor (Office)

Requirement	Timing	Contact	Responsible Person
report to be submitted if there is a recordable incident, thus nil reports are not required.			
Reportable incident As defined within the OPGGS(E)R, a reportable incident is an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage. In the context of the Beach Environmental Risk Matrix moderate to significant environmental damage is defined as any incident of actual or potential consequence category Serious (3) or greater. These risks include: • any loss of well control event. • any vessel collision resulting in a loss of containment or otherwise. • unauthorised entry of vessel into the 500 m rig safety zone. • introduction of marine pests to the drilling location from MODU, support vessel or mooring equipment.			
Verbal notification The notification must contain: • all material facts and circumstances concerning the incident; • any action taken to avoid or mitigate the adverse environmental impact of the incident; and • the corrective action that has been taken or is proposed to be taken to stop control or remedy the reportable incident.	Within two hours of becoming aware of incident	• NOPSEMA – 08 6461 7090 • NOPSEMA – submissions@nopsema.gov.au • DJPR – marine.pollution@ecodev.vic.gov.au (0409 858 715) • NOPTA – reporting@nopta.gov.au	Drilling Superintendent (or delegate)
Written notification Verbal notification of a reportable incident to the regulator must be followed by a written report. As a minimum, the written incident report will include: • the incident and all material facts and circumstances concerning the incident; • actions taken to avoid or mitigate any adverse environmental impacts; • the corrective actions that have been taken, or may be taken, to prevent a recurrence of the incident; and • the action that has been taken or is proposed to be taken to prevent a similar incident occurring in the future.	Within 3 days of notification of incident	• NOPSEMA – submissions@nopsema.gov.au	Drilling HSE Advisor (Office)

Requirement	Timing	Contact	Responsible Person
Written incident reports to be submitted to NOPTA and DJPR (for incidents in Commonwealth waters).	Within 7 days of written report submission to NOPSEMA	• DJPR – marine.pollution@ecodev.vic.gov.au • NOPTA – reporting@nopta.gov.au	Drilling HSE Advisor (Office)
Vessel spill to marine environment All discharges /spills or probable discharges/spills to the marine environment of oil or oily mixtures, or noxious liquid substances in the marine environment from vessels. Reporting info: http://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf.	Verbal notification ASAP	Immediate notification by the Vessel Master to AMSA. Follow-up with Marine Pollution Report (POLREP). • Ph: 1800 641 792 • Email: rccaus@amsa.gov.au • AMSA POLREP: https://amsa-forms.nogginoca.com/public/	Vessel Master
AMP – in the event an AMP may be exposed to hydrocarbons	Verbal notification ASAP	• Marine Park Compliance Duty Officer – 0419 293 465 Notification must be provided to the Director of National Parks and include: • titleholder details; • time and location of the incident (including name of marine park likely to be affected); • proposed response arrangement; • confirmation of providing access to relevant monitoring and evaluation reports when available; and • contact details for the response coordinator.	EMT Lead (or delegate)
Vessel strike with cetacean	Within 72 hours	• DAWE – online National Ship Strike Database https://data.marinemammals.gov.au/report/shipstrike	Vessel Master / Drilling HSE Advisor (Office)
	ASAP for cetacean injury assistance	• Department of Environment, Land, Water and Planning (Whale and Dolphin Emergency Hotline) – 1300 136 017 • Seals, Penguins or Marine Turtles 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678.	Vessel Master / Drilling HSE Advisor (Office)
Injury to or death of EPBC Act-listed species	Within seven days	• DAWE – 1800 803 772	Drilling HSE Advisor (Office)

Requirement	Timing	Contact	Responsible Person
		• EPBC.Permits@environment.gov.au	
Suspected or confirmed Invasive Marine Species introduction	Verbal notification ASAP	Department of Environment, Land, Water and Planning – 136 186	Drilling HSE Advisor (Office)
Identification of any historic shipwrecks, aircraft or relics	Written notification within 1 week	Written notification via the notification of discovery of an historic shipwreck or relic online submission form.	Drilling HSE Advisor (Office)
Loss of anchor buoy	Verbal notification ASAP	Report to AMSA • Ph: 1800 641 792 • Email: reports@amsa.gov.au	Anchor contractor

8.10 Performance measurement and reporting (HSEMS Standard 9)

The performance measurement and reporting standard specifies that HSE performance data is collected, analysed and reported to monitor and evaluate ongoing HSE performance and drive continual improvement.

8.10.1 Annual performance report

In accordance with OPGGS(E) Regulation 14(2), Beach will submit a report on the environmental performance of the activity to NOPSEMA. Performance will be measured against the EPOs and EPSs described in this EP. The report will be submitted not more than three months after the anniversary date of the EP acceptance by NOPSEMA. The interval between reports will not be more than one year.

8.10.2 Emissions and discharge records

In accordance with OPGGS(E) Regulation 14(7), emissions and discharges shall be recorded for the duration of the activity. Table 8-4 details the types of emissions and discharges that shall be recorded including the monitoring method and frequency of reporting.

Table 8-4: Emissions and discharges monitoring requirements

Emission / Discharge	Monitoring parameter	Recording method	Reporting frequency	Responsibility
Fuel – vessel	Volume used	Daily report	Monthly	Vessel Operator
Fuel – MODU	Volume used	Daily report	Monthly	Drilling Contractor
Bilge	Volume discharged	Daily report	Monthly	Drilling Contractor
Sewage	Volume discharged	Daily report	Monthly	Drilling Contractor
Putrescible food	Volume discharged	Daily report	Monthly	Drilling Contractor
Hydraulic control fluids	Chemical name Volume discharged	Daily report	Monthly	Drilling Contractor
Drill fluids and cuttings	Chemical name Chemical quantity Fluid type Fluid volume % ROC	Daily report	Monthly	Drill fluid Service Provider
Cement	Chemical name Chemical quantity	Daily report	Monthly	Cementing Service Provider
Spills to sea	Chemical / hydrocarbon type Volume discharged	Daily report	As occurs	Drilling Contractor / Vessel Master
Waste lost to the marine environment	Material lost	Daily report	As occurs	Drilling Contractor / Vessel Master
Whale sighting	Species, number, behaviour and any actions taken by vessel	Daily report DAWE sighting sheets	As occurs	Vessel master

8.11 Operational control (HSEMS Standard 10)

The intent of this standard is that all activities that have the potential to cause harm to the health and safety of people or the environment are carried out in accordance with plans and procedures to ensure safe work practices.

Whilst Beach is the Titleholder undertaking the petroleum activity, the drilling contractor maintains operational control of the MODU in accordance with the requirements of the MODU-specific Safety Case as accepted by NOPSEMA and the drilling contractor's Management System.

The activity will be carried out in accordance with the implementation strategy (Section 8) and the EPOs and EPSs detailed in Section 7.20.

8.12 Management of change (HSEMS Standard 11)

This standard requires that all temporary and permanent changes to the organisation, personnel, systems, critical 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 is in accordance with the Management of Change (MOC) Directive to ensure that all proposed changes are adequately defined, implemented, reviewed and documented by suitably competent persons. This process is managed using an electronic tracking database, which provides assurance that all engineering and regulatory requirements have both been considered and met before any change is operational. The MOC process includes not just plant and equipment changes but also critical documented procedures where there is an HSE impact, regulatory documents and organisational changes that impact personnel in safety critical roles.

Not all changes will require a MoC. Each change will be assessed on a case by case basis. The potential environmental impacts will be reviewed by the Environment Manager to see if they warrant a full MoC process. This review will be documented and recorded. It will either for part of the MoC or will document why and MoC was not consider appropriate for managing the environmental risk.

Where risk and hazard review processes as nominated in Section 8.8 identify a change in hazards, controls, or risk (See Section 7) and triggers a regulator requirement to revise this EP, the revision shall be defined, endorsed, completed and communicated in accordance with the Management of Change Directive.

8.13 Facilities design, construction, commissioning and decommissioning (HSEMS Standard 12)

The intent of this standard is to ensure that the assessment and management of HSE risks is an integral part of project design, construction and commissioning to enable sound HSE performance throughout the construction and operational life of the facility. Decommissioning plans were not developed for this project due to the limited scope (one exploration well). The wellhead will either be removed (decommissioned) or left suspended for future use. This forms part of the 'facility' design and construction.

Section 6 details the assessment and management of environmental impacts and risks for the activity and Section 7 details how the activity will be managed to ensure that the impacts and risks are ALARP and an acceptable level.

8.14 Contractors, suppliers, partners and visitors (HSEMS Standard 13)

The intent of this standard is that contractors, suppliers and partners are assessed for their capabilities and competencies to perform work on behalf of Beach, and to ensure their HSE performance is aligned with these Standards.

Section 8.24.1 details how the contractors will be assessed to ensure they have the capabilities and competencies to implement the control measures identified in Section 7.

All suppliers go through a detailed procurement process to ensure that they are capable of meeting the requirements of this project. This includes a review of their HSE performance.

8.15 Crisis and emergency management (HSEMS Standard 14)

The intent of the crisis and emergency response management standard is to ensure that plans, procedures and resources are in place to effectively respond to crisis and emergency situations, to protect the workforce, the environment, the public and customers, and to preserve the company's assets and reputation.

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 8-2. The responsibilities of the Emergency Response Team (ERT), Emergency Management Team (EMT), Wells Emergency Team (WET) and Crisis Management Team (CMT) are outlined in Table 8-5.

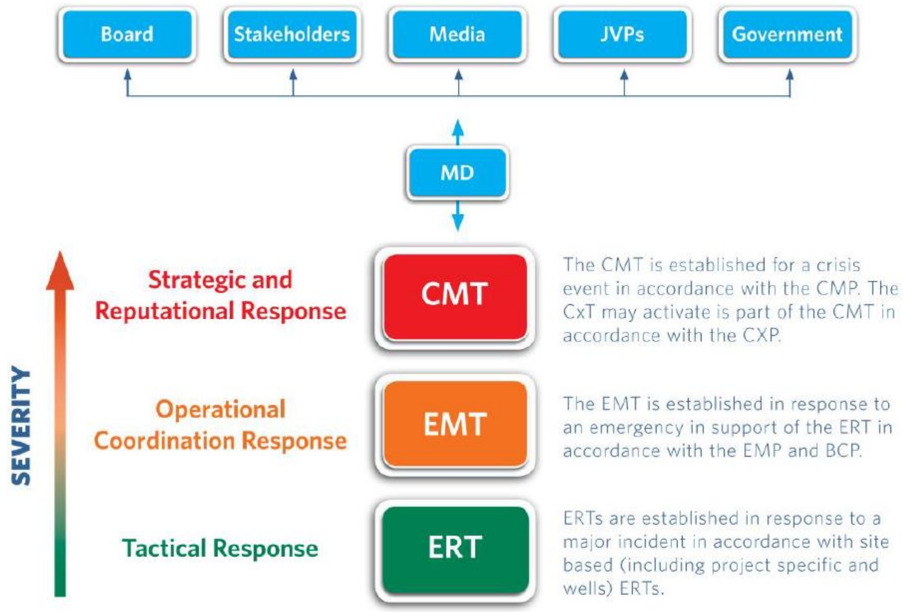

Figure 8-2: Beach crisis and emergency management framework

Table 8-5: Responsibilities of the Beach CMT, EMT, WET & ERT

Team	Base	Responsibilities
CMT	Adelaide head office	• strategic management of Beach's response and recovery efforts in accordance with the Crisis Management Plan. • provide overall direction, strategic decision-making as well as providing corporate protection and support to activated response teams. • activate the Crisis Communication Team if required.
EMT	Adelaide, Melbourne	• 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 site-specific Emergency Response Plan. • regulatory reporting.
WET	Adelaide	• the WET interface with the MODU and implement Beach source control procedures in the event of a LOWC.
ERT	Site	• respond to the emergency in accordance with the site-specific ERP. • in the event of an emergency at Wells/Drilling site, the ERP of the Drilling Contractor is activated along-side that of the Beach Well Control Bridging document.

8.16 Oil Pollution Emergency Plan

Oil spill response arrangements associated with this drilling activity are detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (OPEP) (CDN/ID S4100AH717907).

8.16.1 Operational and Scientific Monitoring Plan

Operational and scientific monitoring arrangement associated with this drilling activity are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and Artisan-1 OSMP Addendum (CDN/ID S4100AH718805).

Table 8-6 and Table 8-7 detail particular values and sensitivities that may require monitoring in the event of a worst-case discharge from Artisan-1 well location and based upon conservative (low exposure) in-water thresholds, specifically: Australian Marine Park (AMP), Marine National Park (MNP), Marine Park (MP) and RAMSAR wetlands. There was shoreline contact at low exposure thresholds predicted for condensate release, but no intersection with RAMSAR wetlands; there was no shoreline contact predicted for the diesel release. Surface exposure was typically restricted to the immediate vicinity of the release location, however a low probability (1%) of exposure to the Apollo MP was predicted for the diesel release, and a low probability (3%) of exposure to the Twelve Apostles Marine National Park was predicted for the condensate release. These identified values and sensitivities are not exhaustive, as other receptors may also require monitoring in the event of a Level 2 or Level 3 hydrocarbon spill but provide an indication of the potential extent of hydrocarbon contact to formally managed areas.

Table 8-6: Environment potentially exposure to low in-water thresholds – diesel release from Artisan-1 well location

		Summer				Winter			
		Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)	Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)
Receptor type	**Receptor name**								
AMP	Apollo	3	22	25	406	5	24	54	501
	Beagle	-	-	-	-	-	-	2	11
MNP	Discovery Bay	-	-	3	25	-	-	-	-
	Point Addis	-	-	-	-	-	-	2	17
	Port Philip Heads	-	-	-	-	-	-	4	19
	Twelve Apostles	-	-	26	278	-	-	15	283
	Wilsons Promontory	-	-	-	-	-	-	3	16
MP	Lower South East	-	-	2	22	-	-	-	-
RAMSAR	Port Philip Bay and Bellarine Peninsula	-	-	-	-	-	-	1	10

Table 8-7: Environment potentially exposure to low in-water thresholds – condensate release from Artisan-1 well location

		Summer				Winter			
		Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)	Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)
Receptor type	**Receptor name**								
AMP	Apollo	98	225	98	255	100	237	100	225
	Beagle	2	10	14	15	13	37	40	24
	Murray	-	-	1	10	-	-	-	-
	Nelson	3	18	-	-	-	-	-	-
	Zeehan	4	23	8	14	-	-	-	-
MNP	Bunurong	1	7	19	14	10	34	29	15
	Cape Howe	-	-	-	-	-	-	11	14
	Churhill Island	2	7	12	13	1	8	16	16
	Discovery Bay	15	41	20	17	-	-		
	Point Addis	14	34	49	41	41	51	72	38
	Port Philip Heads	7	21	49	35	8	15	59	30
	Twelve Apostles	99	217	100	302	100	155	100	230
	Wilsons Promontory	4	13	22	26	23	66	74	84
MP	Batemans	-	-	-	-	-	-	8	12
	Lower South East	3	16	16	13	-	-	-	-

		Summer				Winter			
		Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)	Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)
Receptor type	**Receptor name**								
RAMSAR	Corner Inlet	-	-	2	11			10	12
	Port Philip Bay and Bellarine Peninsula	4	31	39	25	2	14	27	23
	Western Port	2	12	19	24	2	22	30	21

8.16.2 Testing of spill response arrangements

In accordance with Regulation 14(8A)(8C) of the OPGGS(E)R and HSEMS Standard 16: Crisis and Emergency Preparedness and Response, the response arrangements will be tested:

- when they are introduced;
- when they are significantly amended; and
- not later than 12 months after the most recent test.

Prior to commencing drilling activities, spill response arrangements applicable to a LOWC scenario will be tested as per Table 17 of the OPEP. 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.

8.17 Plant and equipment (HSEMS Standard 15)

The intent of this performance standard is that Beach's facilities, plant, equipment, machinery and tools are purchased, designed, constructed, commissioned, operated, maintained, modified and decommissioned in a manner that ensures HSE risks are effectively managed.

Plant and equipment that have been identified as a control measure for the purposed of managing potential environmental impacts and risks from the activity have an associated environmental performance standard that details the performance required of the plant and/or equipment as detailed in Section 7.20.

8.18 Monitoring the working environment (HSEMS Standard 16)

The intent of this performance standard is that HSE risks to personnel associated within the working environment are eliminated or reduced to ALARP. See section 8.23.1

8.19 Health and fitness for work (HSEMS Standard 17)

Beach encourages a healthy lifestyle for its employees and provides formal programs to promote health and fitness.

8.20 Environment effects and management (HSEMS Standard 18)

The intent of this performance standard is that potential adverse environmental effects resulting from Beach's operations and activities are identified, assessed and monitored and as far as is reasonably practicable, eliminated or minimised.

Section 7 details the assessment undertaken of the activity to identify and assess potential impacts and risks and apply control measure to manages the impacts and risk to ALARP and an acceptable level.

8.21 Hazardous materials assessment process

The Hazardous Materials and Secondary Containment Directive detail the process for the assessing and approving hazardous materials such as chemicals that are used on Beach sites or activities. The Directive requires that where a hazardous material will or may be discharged offshore a risk assessment is required. The risk assessment is documented using the Hazardous Material Risk Assessment Form

Figure 8-3 provides a summary of the Beach offshore chemical environmental risk assessment process. The risk assessment process considers aquatic toxicity, bioaccumulation and persistence data, along with the discharge concentration, duration, frequency, rate, and volume. The assessed level of risk determines the acceptance authority (in accordance with the Risk Management Plan) for approving the material for use. Approval is recorded on the Hazardous Material Risk Assessment Form.

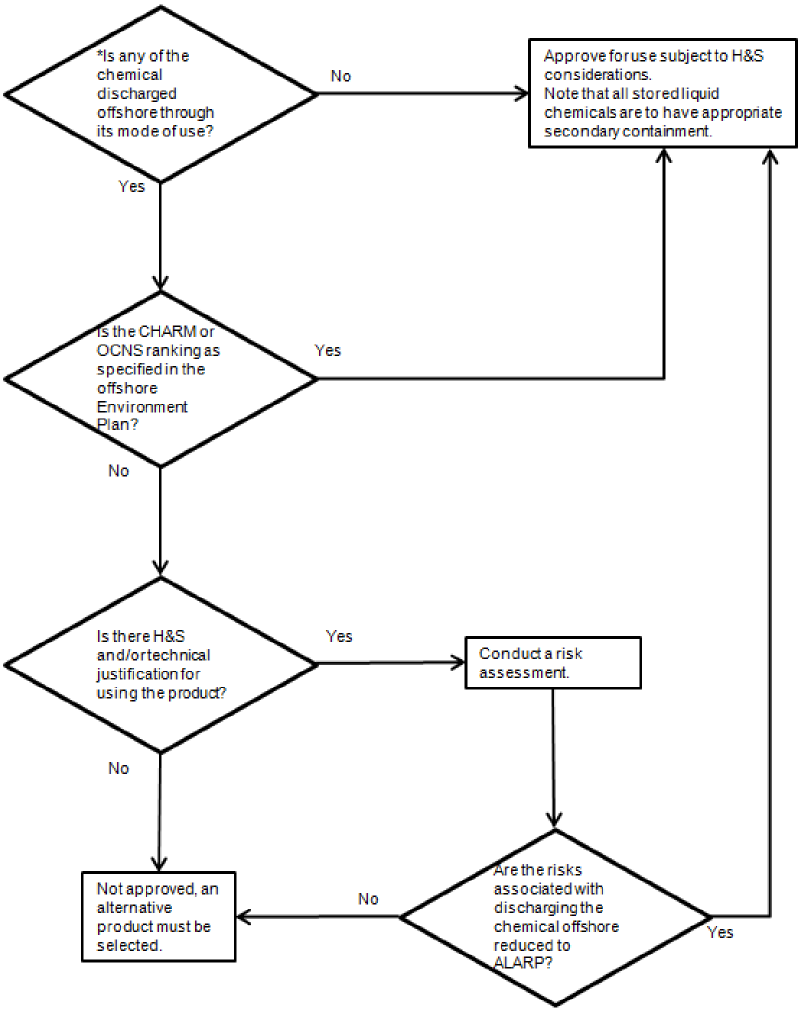

Figure 8-3: Beach offshore chemical environmental risk assessment process summary

8.21.1 Assessment of offshore drilling chemicals in alignment with OCNS and IFC recommendations

In terms of approving hazardous materials for use offshore, the procedure refers to the Offshore Chemical Notification Scheme (OCNS).

All production and drilling chemicals or products used in the North Sea offshore oil industry are evaluated under the requirements of international legislation established by the Oslo Paris (OSPAR) Convention 1992, in order to monitor their environmental impact. Under this Convention, organic-based compounds used in production and workovers are subject to the Chemical Hazard Assessment and Risk Management (CHARM) model which calculates the ratio of the Predicted Effect Concentration against the No Effect Concentration. This is expressed as a Hazard Quotient (HQ) and associated with a colour to rank the product and the level of hazard.

These results are then published on the Definitive Ranked Lists of Approved Products by the OCNS. The OCNS manages chemical use and discharge by the UK and Netherlands offshore petroleum industries. The scheme is regulated in the UK by the Department of Energy and Climate Change using scientific and environmental advice from CEFAS (the UK's Centre for Environment, Fisheries and Aquaculture Science) and Marine Scotland. In the absence of a similar system in Australia, the OCNS is utilised by Beach to review the environmental acceptability of chemicals at Otway facilities as part of their chemical approval process as set out below.

The CHARM model requires biodegradation, bioaccumulation and toxicity of a product to be calculated. Testing is carried out on the effect of the product on three different species of aquatic organism: algae, crustaceans and fish.

Table 8-8: The OCNS CHARM Hazard Quotient and colour bands

Minimum HQ Value	Maximum HQ Value	Colour Banding	Hazard
>0	<1	Gold	Lowest Hazard
≥1	<30	Silver	
≥30	<100	White	
≥100	<300	Blue	
≥300	<1000	Orange	
≥1000		Purple	Highest Hazard

Products not applicable to the CHARM model (i.e., inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with 'A' being the greatest potential environmental hazard and 'E' being the least. Products that only contain substances termed PLONORs (Pose Little or No Risk) are given the OCNS 'E' grouping. Data used for the assessment includes toxicity, biodegradation and bioaccumulation.

Table 8-9: The OCNS Non-CHARM environmental ranking system for inorganic substances

OCNS Grouping	Results for Aquatic Toxicity (mg/L)	Results for Sediment Toxicity (mg/L)
A	<1	<10
B	>1-10	>10-100
C	>10-100	>100-1000
D	>100-1000	>1000-10000
E	>1000	>10000

OCNS incorporates "operational" chemicals/products which, through their mode of use, are expected in some proportion to be discharged. The scheme does not apply to chemicals that might otherwise be used on a ship, helicopter or other offshore structure. Products used solely within domestic accommodation areas – such as additives to potable water systems, paints and other coatings, fuels, lubricants, fire-fighting foams, hydraulic fluids used in cranes and other machinery – are also exempt.

The Hazardous Material Risk Assessment Form is used to ensure that the impacts and risks associated with offshore discharge are reduced to ALARP. The form includes a flow chart to assist in determining whether an environmental risk assessment is required to approve the material for use and discharge offshore.

The risk assessment process considers aquatic toxicity, bioaccumulation and persistence data, along with the discharge concentration, duration, frequency, rate, and volume. Approval is recorded in the Hazardous Materials Register – Offshore Drilling.

Beach also apply the following recommendation derived from the Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development (IFC, June 5, 2015):

- Drilling fluids to be discharged to sea (including as residual material on drilled cuttings) are subject to tests for toxicity, barite contamination, and oil content. Barite contamination by mercury (Hg) and cadmium (Cd) must be checked to ensure compliance with the discharge limits provided in Table 8-10. Suppliers should be asked to guarantee that barite quality meets this standard with pre-treatment, if necessary.

Table 8-10: Drill fluid and cuttings parameters (IFC, June, 2015)

Parameter	Guideline
Drill Fluids and Cuttings – WBDF & NADF	• Hg: max 1 mg/kg dry weight in stock barite; and • Cd: max 3 mg/kg dry weight in stock barite

- the following additional principles should be followed for the management of hazardous materials offshore:
  - use chemical hazard assessment and risk management techniques to evaluate chemicals and their effects;
  - select only those chemicals that have been previously tested for environmental hazards;
  - select chemicals based on the OSPAR Harmonised Offshore Chemical Notification Format or similar internationally recognized system;
  - select chemicals with the least hazard and lowest potential environmental and health risks, whenever possible;
  - avoid chemicals suspected to cause taint or known endocrine disruptors; and
  - avoid chemicals known to contain heavy metals of concern, in anything other than trace quantities.

8.21.2 Drilling chemicals acceptance criteria

The following acceptance criteria shall be applied to all drilling chemicals:

- CHARM Gold or Silver or OCNS Category E (PLONOR) or D rated chemicals are acceptable for use
- any rated or non-rated chemicals shall be risk assessed and those deemed ‘Persistent’, ‘Bioaccumulative’, and ‘Toxic’ (or ‘very persistent’ or ‘very bioaccumulative’) shall be deemed unacceptable for use, irrespective of concentration or proposed application volume.
- any proposed chemical that is not listed on the listed on the Australian Inventory of Chemical Substances (AICS) under the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) shall be deemed unacceptable for use, irrespective of concentration or proposed application volume.
- Beach shall monitor the Centre for Environment, Fisheries and Aquaculture Science (Cefas) substation warning register to identify chemicals which are hazardous to the marine environment are subject to substitution warnings under the Harmonised Mandatory Control Scheme (HMCS). Chemicals identified for substitution shall be eliminated from the supply chain and remaining stock is exhausted.
  - stock barite shall have heavy metal concentrations no greater than:

- mercury – maximum 1 mg/kg dry weight in stock barite;
- cadmium – maximum 3 mg/kg dry weight in stock barite; and
- lead – maximum 1000 mg/kg dry weight in stock barite.

8.22 Beach Energy Domestic IMS Biofouling Risk Assessment Process

Scope

All MODUs, vessels and submersible equipment mobilised from domestic waters to undertake offshore petroleum activities within the operational area must complete the Beach Domestic IMS Biofouling Risk Assessment Process as detailed in the Beach Introduced Marine Species Management Plan (S400AH719916) prior to the initial mobilisation into the operational area.

This domestic IMS biofouling risk assessment process does not include an evaluation of potential risks associated with ballast water exchange given all MODU and vessel operators contracted to Beach must comply with the most recent version of the Australian Ballast Water Management Requirements.

Purpose

- Validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational / project area;
- Identify the potential IMS risk profile of MODUs, vessels and submersible equipment prior to deployment within the operational / project area;
- Identify potential deficiencies of IMS controls prior to entering the operational area;
- Identify additional controls to manage IMS risk; and
- Prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational / project area).

Screening Assessment

Prior to the initial mobilisation of the MODU, vessels or submersible equipment to the operational / project area, a screening assessment must be undertaken considering:

- All relevant IMO and regulatory requirements under the Australian Biosecurity Act 2015 and/or relevant Australian State or Territory legislation must be met;
- If mobilising from a high or uncertain risk area, the MODU / vessel / submersible equipment must have been within that area for fewer than 7 consecutive days or inspected and deemed low-risk by an independent IMS expert, within 7 days of departure from the area;
- Vessels must have valid antifouling coatings based upon manufacturers specifications;
- Vessels must have a biofouling control treatment system in use for key internal seawater systems; and
- MODUs and vessels must have a Biofouling Management Plan and record book consistent with the International Maritime Organization (IMO) 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO Biofouling Guidelines).

Where relevant criteria have been met, no further management measures are required, and the MODU / vessel / submersible equipment may be deployed into the operational / project area.

Where relevant criteria have not been met, or there is uncertainty if these criteria have been met, Beach must engage an independent IMS expert to undertake a detailed biosecurity risk assessment, and the MODU / vessel / submersible equipment must be deemed low-risk prior to mobilisation into the operational / project area.

Basis of Detailed IMS Biofouling Risk Assessment

The basis by which an independent IMS expert evaluates the risk profile of a MODU / vessel / submersible equipment includes:

- The age, type and condition of the MODU / vessel / submersible equipment;
- Previous cleaning and inspection undertaken and the outcomes of previous inspections;
- Assessment of internal niches with potential to harbour IMS;
- The MODU / vessel / equipment history since previous inspection;
- The origin of the MODU / vessel / submersible equipment including potential for exposure to IMS;
- Translocation risk based upon source location in relation to activity location – both in relation to the water depth / proximity to land at the point of origin and the potential survivorship of IMS from the point of origin to the operational / project area;
- The mobilisation method – whether dry or in-water (including duration of low-speed transit through high or uncertain risk areas);
- For vessels, the application, age and condition of antifouling coatings;
- presence and condition of internal seawater treatment systems;
- Assessment of Biofouling Management Plan and record book against IMO Biofouling Guidelines; and
- Where appropriate, undertake in-water inspections.

8.23 Product stewardship, conservation and waste management (HSEMS Standard 19)

This standard requires that the lifecycle HSE impacts of Beach's products and services are assessed and communicated to customers and users to enable responsible usage management. Consumption of resources and materials is minimised as far as reasonably practicable. Wastes are eliminated, reduced, recycled and/or reused as far as reasonably practicable or disposed of appropriately.

General and hazardous waste streams generated during the activity are backloaded to port for disposal to a licenced waste facility by a licenced waste handling contractor. Wastewater and putrescible wastes are managed as per MARPOL requirements as detailed in Section 7.

8.24 Audits, assessments and review (HSEMS Standard 20)

The audits, assessment and review standard is in place to ensure that HSE performance and systems are monitored and assessed through periodic reports and audits to identify trends, measure progress, assess conformance and drive continual improvement. Management system reviews are conducted to ensure the continuing suitability, adequacy and effectiveness of the HSEMS.

8.24.1 Audits and assessments

Environmental performance will be reviewed in several ways to ensure:

- EPSs to achieve the EPOs are being implemented and reviewed.
- potential non-compliances and opportunities for continuous improvement are identified.
- environmental monitoring and reporting requirements have been met.

A pre-mobilisation audit will be undertaken at least two weeks prior to commencement of drilling operations of the EPOs and EPSs in this EP and the requirements detailed in the implementation strategy, followed by an additional offshore audit within 2 weeks of mobilisation to the drill site. The audit will inform the annual performance report submitted to the relevant regulator as per Section 8.10.1.

For offshore activities undertaken by the vessel the following will be undertaken:

- premobilisation inspection of each vessel (desktop or site) to confirm the requirements of the EP will be met.

For offshore activities undertaken by the MODU the Beach shall undertake the following:

- premobilisation inspection of the MODU (desktop or site) to confirm the requirements of the EP will be met.
- weekly offshore inspections throughout the activity to ensure ongoing compliance with relevant EP requirements. Inspection will include, but not be limited to:
  - spill preparedness such as spill kit checks;
  - waste management;
  - review of any new or changed chemicals that maybe discharged offshore;
  - validation all EPOs and EPSs relevant to offshore operations are maintained as per Table 7-17; and
  - compliance with procedural controls relevant to environmental management of the MODU and drilling activity such as: bunkering and drill fluids and cuttings management.

Non-compliances and opportunities for improvements identified via audits, inspections or other means are communicated to the appropriate supervisor and/or manager to report and action in a timely manner. Tracking of non-compliances and audit actions will be undertaken using Beach's incident management system which includes assigning a responsible person for ensuring the action is addressed and closed out.

Non-compliances are communicated via the daily report and pre-start meetings.

8.24.2 Environment plan review

Beach may determine that a review of the EP is required when one or more of the following occurs:

- changes to impacts and risks and/or controls identified during the activity.
- annual environmental performance reporting identifies issues in the EP that require review and/or updating.
- implementation of corrective actions to address internal audits findings or external inspection recommendations.

- an environmental incident and subsequent investigation identify issues in the EP that require review and/or updating.
- a modification of the activity is proposed that is not significant but needs to be documented in the EP.
- changes to risk and controls identified through the Risk Management Processes as per Section 8.8.
- new information or changes in information from stakeholders, legal and other requirements. This shall be achieved by:
  - subscription to regulator and relevant industry distribution lists (such as APPEA and IOGP);
  - subscription to the NOPSEMA website to identify any new petroleum activities within the Otway Basin that may overlap with the Artisan-1 drilling location and timing;
  - annual review of the EP inclusive of relevant regulatory requirements (when in force for longer than 12 months); and
  - ongoing Stakeholder communications.

Where the EP is revised the changes are to be logged in the EP Revision Change Register in Appendix C. Any revisions to the EP are to be assessed against the criteria for submission of a revised EP to NOPSEMA as detailed in Table 8-11 and Management of Change as per Section 8.12 shall be evaluated.

8.24.3 Environment plan revision

In accordance with Regulation 17 of the OPGGS(E)R, a revision of this EP shall be submitted to NOPSEMA as per the regulatory requirements in Table 8-11.

Table 8-11: Regulatory requirements for submission of a revised EP

OPGGS(E) R	EP Revision Submission Requirements
17(1)	With the regulator's approval before the commencement of a new activity.
17(5)	Before the commencement of any significant modification or new stage of the activity that is not provided for in the EP as currently in force.
17(6)	Before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk; or The occurrence of a series of new or a series of increases in existing environmental impacts or risks which, taken together, amount to the occurrence of a significant new or significant increase in environmental impact or risk.
17(7)	A change in titleholder that results in a change in the manner in which the environmental impacts and risks of an activity are managed.

9 Stakeholder Consultation

Stakeholder consultation was undertaken in line with current NOPSEMA guidelines on consultation requirements under the OPGGS(E)R.

Beach is committed to open, on-going and effective engagement with the communities in which it operates and providing information that is clear, relevant and easily understandable. Beach welcomes feedback and is continuously endeavouring to learn from experience in order to manage our risks.

9.1 Regulatory requirements

Section 280 of the OPGGS Act states that a person carrying out activities in an offshore permit area should not interfere with other users of the offshore area to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.

In relation to the content of an EP, more specific requirements are defined in the OPGGS (E) Regulation 11(A). This regulation requires that the Titleholder consult with 'relevant persons' in the preparation of an EP. A relevant person is defined as:

a) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;

b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;

c) the Department of the responsible State Minister, or the responsible Northern Territory Minister;

d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan;

e) any other person or organisation that the titleholder considers relevant.

Regulation 9(8) of the OPGGS(E)R requires all sensitive information (if any) in an environment plan, and the full text of any response by a relevant person to consultation under regulation 11A in the course of preparation of the plan, must be contained in the sensitive information part of the plan and not anywhere else in the plan.

Regulation 9AB of the OPGGS(E)R requires the Regulator must publish (the EP) on the Regulator's website.

In addition, in accordance with regulation 11B of the OPGGS(E)R, when the Regulator publishes a seismic or exploratory drilling environment plan (with the sensitive information part removed) on the Regulator's website under regulation 9AB, the Regulator must also publish in the same place an invitation for any person:

a) to give the Regulator, within 30 days, written comments on the matters described in Division 2.3 (Contents of an environment plan) in relation to the plan; and

b) to request in the person's comments that particular information in the comments not be published.

Regulation 14(9) of the OPGGS(E)R also defines a requirement for ongoing consultation to be incorporated into the Implementation Strategy. In addition, Regulation 16(b) of the OPGGS(E)R requires that the EP contain a summary and full text of this consultation. It should be noted that the full text is not made publicly available for privacy reasons.

9.2 Stakeholder consultation objectives

The objectives of Beach's stakeholder consultation in preparation of the EP were to:

- identify all relevant persons for stakeholder consultation.
- engage with stakeholders and the community in an open, transparent, timely and responsive manner.
- minimise community and stakeholders concern where practicable.
- build and maintain trust with stakeholders and the local community.
- demonstrate that stakeholders have been consulted in line with the requirements of the relevant regulations.

The objectives were achieved by:

- identifying stakeholders whose functions, interests or activities may be affected by the activity.
- confirming, through consultation, 'relevant persons' (stakeholders) and engaging them at the earliest opportunity.
- providing sufficient information to allow relevant persons to make an informed assessment of the possible consequences of the activity on their functions, interests or activities.
- ensuring relevant persons are informed about the process for consultation and their feedback is considered in the development of the EP.
- ensuring that issues raised by relevant persons are adequately assessed, and where requested or relevant, responses to feedback are communicated back to them.
- providing a copy of this EP to NOPSEMA for publication on the NOPSEMA website as per regulation 11B of the OPGGS(E)R.
- ensuring that relevant person sensitive information is not made publicly available.

9.3 Consultation approach

The approach Beach undertook for the activities was:

- identify stakeholders that may be potentially affect by the activities by reviewing its stakeholder database and consulting with existing stakeholders to identify other relevant stakeholders. Beach, previously as Lattice Energy, has operated in the area since the early 2000s, and has built an extensive database of stakeholders from ongoing engagement in relation to both the current operating assets and in executing projects in both the Otway and Gippsland basins.
- determine the possible consequences of the activities on each stakeholders' functions, interests or activities from previous knowledge, reviewing any public statements by the stakeholder as to how they want to be engaged by oil and gas companies and/or consulting with stakeholders.
- provide sufficient information, based on possible consequences and the way they would like to be consulted, for the stakeholder to be able to make an informed assessment of the possible consequences of the activity on their functions, interests or activities.

- allow a reasonable period of time for the stakeholder to review and respond to any information provided, typically two to four weeks.
- provide further information requested by the stakeholder or that became available during the consultation period and allowed a reasonable time for the stakeholder to review and respond. Depending on the information provided this was between one to four weeks.
- ensure relevant stakeholders were informed about the consultation process and how their feedback, questions and concerns were considered in the EP.

9.3.1 Fishery specific consultation approach

From reviewing the existing environment, the main stakeholder group for the activity is commercial fishers. Beach, and previously as Lattice Energy, has a substantial history of engagement with local fisheries. For the drilling activity the consultation strategy for potentially impacted fishers is as follows:

- engage with SIV to identify how best to consult with commercial fishers.
- provide a short information sheet to SIV to mail to their members, including groups such as Victorian Rock Lobster Association and Port Campbell Professional Fishers association. The cover letter requested that fishers identify themselves to SIV if they thought they could be impacted by Beach's activities. The information sheet covered both seabed assessment and drilling programs and a more detailed version was published on Beach's website at https://www.beachenergy.com.au/vic-otway-basin/.
- the mailout was issued on 29 March, with a request that fishers respond by 19 April. To date four fishers have contacted SIV in relation to the Beach activities information.
- Beach also provided information to fishery groups and has been contacted directly by two fishers.
- where fishers have identified that they may be potentially impacted by the activity the following is undertaken:
    - for fishers who have contacted SIV, Beach will meet with SIV to gather information about the fishers fishing patterns and locations and to establish contact for ongoing consultation throughout the project.
    - for fishers who have contacted Beach directly, Beach engaged its Fisheries Liaison Officer to meet with them and gather information about their fishing patterns and locations and to establish contact for ongoing consultation throughout the project.
    - where fishers are providing Beach with sensitive fishing data Beach will provide them Beach's privacy policy and obligations.
    - a Commercial Fisher Operating Protocol (Appendix H) was developed and provided to fishers who have identified that they may be potentially impacted and other relevant stakeholders for their information. The protocol details pre-activity and on-water communication processes, including SMS messages and radio communication on Channel 16, data confidentiality and Beach's claim process. The protocol was developed based on feedback from consultation with the fishers who have identified they could be potentially impacted and SIV who have been contacted by fishers who have identified they could be potentially impacted.
- providing ongoing updates to fishers and fishing groups in relation to the changes in the drill schedule.

- once the drilling schedule and final well locations are confirmed (minimum of 4 weeks prior to commencement of the activity) they will be provided to fishers who have identified they fish in the area, SIV, VFA and other relevant fishing groups who have requested further information.
- Beach is conscious that the duration of drilling may change slightly (subject to operations), and this will be assessed by Beach to determine if it would materially change the information provided to fishers to identify if they would be potentially impacted by the activity. If there is no material change, in order to minimise confusion for fishers and the time required for engagement, Beach will inform relevant stakeholders of any changes a minimum will be 4 weeks prior to the commencement of the activity. If the changes are material, then updated information will be provided to relevant stakeholders.
- the MODU exclusion zone (500 m) and cautionary zone (2 km) will be communicated via Notice to Mariners. Fishers are able to contact the rig via channel 16 rig at any time. The rig will be stationary until it is required to move to the next location.
- Beach will seek permission from the identified fishers to include them in their SMS messaging system. Once the activity commences, Beach will provide SMS messaging system updates 2 days prior to the rig moving to a new location detailing the new location and the expected duration at the location so Fishers can plan their fishing activities with the least disruption.
- Beach's position is that the commercial fisheries cover a vast area and the drilling activity only requires access to a relatively small area (500m rig safety zone and 2 km cautionary zone) over a short period of time and so we aim to minimise impact to each other's activities. However, Beach has a stated position that fishers should not suffer an economic loss as a result of our activities. Should a fisher incur additional costs in order to work around our activities, or if they have lost catch or have damaged equipment Beach will assess the claim and ask for evidence of past fishing history and the loss incurred and, where the claim is genuine, will provide compensation. Beach will also ensure that the evidence required is not burdensome on the fisher while ensuring genuine claims are processed.

9.4 Stakeholder identification

Relevant stakeholders were identified by reviewing:

- social receptors identified in the existing environment section.
- existing stakeholders within Beach's stakeholder register.
- reviewing consultation record for previous Otway Basin activities undertaken by Beach and Lattice.
- Commonwealth and State fisheries jurisdictions and fishing effort in the region.
- the Australian Government Guidance Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area.

The Otway Development commenced production in late February 2008. Woodside Energy, the titleholder at the time, undertook significant consultation with the community, non-government organisations and Government departments. Consultation has been ongoing through the change of titleholders to Origin and then Lattice and now Beach.

Lattice undertook three marine seismic surveys between 2014 and early 2017 and has had regular and detailed engagement with both fishing industry associations and individual fishers over this period. In 2017 Lattice commenced consultation in relation to the Otway Development Phase 4 and associated seabed assessment and drilling activities. Beach then commenced consultation with stakeholders in early 2019 when they decided to progress with the Otway Development Phase 4. Consequently, Beach consider that they have effectively identified relevant stakeholders and have a good understanding of issues and areas of concern within the Otway Development area.

Table 9-1 details the relevant stakeholders identified and groups them by the categories listed under OPGGS(E) Regulation 11A. It should be noted that no fishing effort by Tasmanian fisheries was identified within the operational area.

9.5 Provision of information

The OPGGS(E)R require titleholders to give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person. Additionally, a copy of this EP was published on the NOPSEMA website in June 2019 as per regulation 11B of the OPGGS(E)R.

To determine the type of information to provide to a stakeholder an Information Category was developed and is detailed in Table 9-2.

Information has also been provided in relation to the broader Beach Otway Offshore Gas Development which included information on the activity via:

- community information session held in Port Campbell on 13 February 2019.
- information sheets and information available on the Beach website: https://www.beachenergy.com.au/our-communities/. Information sheets are available in Sensitive Information document.
- an email to stakeholders informing them that the Environment Plan for the Artisan Exploration well, was available for public consultation on the NOPSEMA website.

9.6 Summary of stakeholder consultation

Table 9-4 provides a summary of the stakeholder consultation undertaken as part of the development of the EP. The summary provides details of the information sent to stakeholders and any response received. It also details the assessment undertaken of any objection or claims. Where an objection or claim was substantiated via evidence such as publicly available credible information and/or scientific or fishing data, this were assessed as per the risk assessment process detail in section 9.2 and controls applied where appropriate to ensure impacts and risks are managed to ALARP and an acceptable level.

Where an objection or claim was raised by a stakeholder, they were provided feedback as to whether the objection or claim was substantiated, how it was assessed and if any additional controls were required to manage the impact or risk to ALARP and an acceptable level or if not substantiated why.

No comments were received during the 30-day public consultation period of this EP. As no comments were received a consultation report has not been developed for submission.

Table 9-1: Relevant stakeholders for the activity (refer to Table 9-2 for information category definition)

Stakeholder	Relevance	Information category
Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant		
Australian Fisheries Management Authority (AFMA)	Australian Government agency responsible for the efficient management and sustainable use of Commonwealth fish resources. Activity is within a Commonwealth fishery area. AFMA expects petroleum operators to consult directly with fishing operators or via their fishing association body about all activities and projects which may affect day to day fishing activities.	1
Australian Hydrological Office (AHO)	Australian Government agency responsible for issuing notices to mariners.	2
AMSA JRCC	Australian Government agency responsible for maritime safety, adherence to advice, protocols, regulations. Issue Auscoast warnings	2
Department of Environment and Energy – Director of National Parks	Australian Government agency responsible for MNES and Australian Marine Parks	1
Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP may be relevant		
Victorian Fishery Authority	Activity is within a Victorian fishery area or will impact or potentially impact a Victorian fishery area or resource.	1
The Department of the Responsible State or Northern Territory Minister		
Tasmanian DPIPWE	Regulatory body for oil and gas activities in Tasmanian waters. Required to be notified of reportable incidents. Commencement and cessation notifications are only required for drilling and seismic surveys.	2
DJPR - Earth Resources Regulation	Regulatory body for oil and gas activities in Victorian waters. Required to be notified of reportable incidents. Commencement and cessation notifications are only required for drilling and seismic surveys.	2
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP		
Commonwealth Fisheries Association (CFA)	Peak association representing commercial fishing in Commonwealth fisheries. Industry Association for the following Commonwealth fisheries that have catch effort within the operational area: • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors). • Southern Squid Jig Fishery.	1
Port Campbell Professional Fisherman's Association	Association representing Port Campbell fishers, primarily rock lobster around Port Campbell and Peterborough. Engagement via SIV see Consultation Record #SIV 07.	1
Portland Professional Fishermen's Association	Association representing Portland fishermen.	1

Stakeholder	Relevance	Information category
South East Trawl Fishing Industry Association (SETFIA)	SETFIA represents businesses with a commercial interest in the SETF and the East Coast Deepwater Trawl Sector. SETFIA represent the following fisheries that have catch effort within the operational area: • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors).	1
Seafood Industries Victoria (SIV)	Peak body representing professional fishing, seafood processors and exporters in Victoria. SIV primary contact for State fishers.	1
Southern Rock Lobster Limited South Australian Rock Lobster Advisory Council Inc. South Eastern Professional Fishermen's Association Inc. Tasmanian Rock Lobster Fishermen's Association	Associations representing state-based commercial rock lobster fishers. Associations are represented by one consultancy and are therefore grouped.	1
Victorian Rock Lobster Association (VRLA)	VRLA represents Victorian rock lobster licence holders. Engagement via SIV see Consultation Record #SIV 07.	1
Warrnambool Professional Fishermen's Association	Association represents Warrnambool fishermen, primarily rock lobster on strip from Warrnambool to Port Campbell. Engagement via SIV see Consultation Record #SIV 07.	1
Any other person or organisation that the titleholder considers relevant		
Otway Gas Plant Community Reference Group	Community Reference Group established for the Otway Gas Plant. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Tasmanian Rock Lobster Fisherman's Association	The Tasmanian Rock Lobster Fishermen's Association is the peak commercial fishing body recognised under the Act for the rock lobster fishery. The Development Area does not overlap any Tasmanian rock lobster fishery where there is catch effort. However, Beach maintain engagement in relation to activities within the Otway area.	3
Tasmanian Seafood Industry Council (TSIC)	The TSIC is the peak body representing the interests of wild capture fishers, marine farmers and seafood processors in Tasmania. The Development Area does not overlap any Tasmanian fisheries where there is catch effort. However, Beach maintain engagement in relation to activities within the Otway area.	3

Table 9-2: Information category to determine information provided stakeholder

Information Category	Description	Information Type
1	Organisations or individuals whose functions, interests or activities may be impacted by the activity. Representative body for fishers who provide information to their members.	Information Sheet and/or provision of information as per organisations consultation guidance Provision of further information where required Meeting or phone call where required
2	Organisation who receive activity commencement and cessation notices.	Commencement and cessation notices.
3	Organisations or individuals whose functions, interests or activities will not be impacted by the activity but are kept up to date with Beach's activities in the Otway area.	Information Sheet

9.7 Ongoing stakeholder consultation

As the drilling activity will be undertaken over a two-year period Beach will continue to consult with stakeholders to keep them informed of the drilling schedule and well location coordinates as information becomes available. This will be done via ongoing consultation including commencement and cessation notifications and updates in relation to the drilling activity and broader Otway Offshore Gas Development project via one-on-one communications, mail outs and provision of information on the Beach website. Beach will use a message media system to provide regular information on the drilling activity to stakeholders that have requested this service.

Any objections or claims raised from ongoing consultation will be managed as per Section 9.7.2.

Table 9-4 details the ongoing stakeholder consultation requirements. Records of ongoing stakeholder engagement will be maintained as per Section 8.5.2 Records Management.

9.7.1 Ongoing Identification of Relevant Persons

New or changes to relevant persons will be identified through ongoing consultation with stakeholders including peak industry bodies and the environment plan review process detailed in Section 8.24.2. Should new relevant persons be identified they will be contacted and provided information about the activity relevant to their functions, interests or activities. Any objections or claims raised will be managed as per Section 9.7.2.

9.7.2 Management of objections and claims

If any objections or claims are raised during ongoing consultation these will be substantiated via evidence such as publicly available credible information and/or scientific or fishing data. Where the objection or claim is substantiated it will be assessed as per the risk assessment process detail in Section 6 and controls applied where appropriate to manage impacts and risks to ALARP and an acceptable level. Stakeholders will be provided with feedback as to whether their objection or claim was substantiated, and if not why, and if it was substantiated how it was assessed and if any controls were put in place to manage the impact or risk to ALARP and an acceptable level. If the objection or claim triggers a revision of the EP this will be managed as per Section 8.24.2 and 8.24.3. This will also be communicated to the stakeholder.

Table 9-3: Ongoing stakeholder consultation requirements

Stakeholder	Ongoing stakeholder requirement	Timing
Relevant stakeholders	Ongoing engagement including: • stakeholder communication of information and addressing queries and concerns via email, phone or meeting; and • updates to Beach website.	As required
General	Public notice in local newspapers (i.e. Warrnambool Standard and The Cobden Timboon Coast Time). To include: • activity description; • activity location; • timing; • how to access the EP and project information; and • Beach contact details.	4 weeks prior to activity commencing
Relevant stakeholders	Stakeholder notification of activity commencement. Notification to include: • type of activity; • location of activity, coordinates and map; • timing of activity: expected start and finish date and duration; • sequencing of locations if applicable; • MODU and support vessel details including call sign and contact; • 500 m rig safety exclusion zone and 2 km cautionary zone and requested clearance from other vessels; and • Beach contact details. Note: coordinates to be provided as degrees and decimal minutes referenced to the WGS 84 datum.	4 weeks prior to activity commencing
AHO	Drilling Contractor to issue notification of activity for publication of notice to mariners. Information provided should detail: • type of activity; • geographical coordinates of the well location; • 500 m MODU safety exclusion zone and 2 km cautionary zone and requested clearance from other vessels; • period that NTM will cover (start and finish date); • MODU and vessel details including MODU and vessel names, Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone), contact details and call signs; and • Beach and Rig Contractor contact details. Only need to update AHO of changes including if activity start or finish date changes. Do not need to provide cessation notification as long as NTM covers period of activity.	3 weeks prior to activity commencing
AMSA - JRRC	Drilling Contractor to issue notification of activity for publication of Auscoast warning. Information provided should detail: • type of activity;	48 – 24 hrs prior to activity commencing

Stakeholder	Ongoing stakeholder requirement	Timing
	• geographical coordinates of the well location; • the 500 m rig safety exclusion zone & 2 km cautionary zone and requested clearance from other vessels; • period that warning will cover (start and finish date); • vessel and or rig details including vessel name, call-sign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone), contact details and calls signs; and • Beach & Rig Contractor contact person. Only need to update JRCC of changes including if activity start of finish date changes. Do not need to provide cessation notification as long as Auscoast warning covers period of activity.	
NOPSEMA DJPR DPIPWE	Regulatory notification of start of activity.	10 days prior to activity commencing
Relevant stakeholders who have requested MODU location information.	SMS messaging system updates 2 days prior to the rig moving to a new location detailing the new location and the expected duration at the location.	During activity
NOPSEMA DJPR DPIPWE	Regulatory notification of cessation of activity.	Within 10 days of activity completion
DAWE	To be notified in the instance of an overlap with a marine park or new impact, or for emergency responses.	New impact identified and / or Oil Pollution Emergency

Table 9-4: Summary of stakeholder consultation records and Beach assessment of objections and claims

Information sheets OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1, OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet, OPOG19IS#1, OPOG19IS#2 and OP19-USAIS-P2/7 are available in Sensitive Information document

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Australian Communications and Media Authority (ACMA)	27/03/2019 to 17/04/2019	ACMA 01 to ACMA 11	Request for Indigo Central submarine cable coordinates ACMA provided coordinates and a map showing that the cable is ~ 50 km from the Thylacine platform. Beach acknowledge information and note that the planned activities will not interfere with the cable.	Indigo Central Submarine Cable is ~ 65 km from the Artisan-1 well location and therefore out of the operational areas for the drilling activity.
Australian Fisheries Management Authority (AFMA)	18/04/2019	AFMA 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Email: Introducing Beach Energy and provision of information on the 'Otway Offshore Project and a summary of Beach's review of Commonwealth fisheries in the project area. A review of the AFMA website identified that the operational area where the seabed assessments and drilling activities are planned to occur over the following Commonwealth fisheries: • Bass Strait Central Zone Scallop Fishery; • Eastern Tuna and Billfish Fishery; • Skipjack Tuna Fishery (Eastern); • Small Pelagic Fishery (Western sub-area); • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors); • Southern Bluefin Tuna Fishery; and • Southern Squid Jig Fishery. However, a review of the ABARES Fishery Status Reports 2014 to 2018 identified that only the following have catch effort within the operational area: • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors); and • Southern Squid Jig Fishery. Information has been provided to AFMA and the following fishing associations: • Scallop Fisherman's Association Inc.; • SIV – SIV have sent out the information sheet attached to their members; • Tuna Australia (ETBF Industry Association); and • SETFIA. The main concerns raised by commercial fishers are sound from the seabed assessment and displacement while the activities occur. Sound from the seabed assessment equipment is of significantly lower intensity than for seismic surveys. Sound modelling identified that the sound threshold level for fish was reached at a maximum distance of 1.6 m from the equipment and did not reach the impact threshold for invertebrates at the seafloor. The seabed assessment areas will take up to 12 days for the largest area. Drilling at each location will range from 35 to 90 days with fishers not being able to access a 500 m area around the MODU. Thus, the area of displacement is small and not for a significant period of time.	Provision of information. No reply.
Australian Fisheries Management Authority (AFMA)	24/06/2019 27/06/2019	AFMA 02	Beach request for licensing information for any Commonwealth fishers who are active within the Beach Otway Development operational area. Provided AFMA the coordinates for the operational area. AFMA replied: Our Vessel Monitoring Team checked the area you outlined and there are currently no vessel's active in that area.	Appendix B4.7 Commonwealth Managed Fisheries updated with the information that there is currently no active Commonwealth fishing vessels within the operational area.
Australian Fisheries Management	10/07/2019	AFMA 03	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Authority (AFMA)			As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	
Australian Hydrographic Office (AHO)	29/03/2019	AHO 01	Rang AHO to clarify requirement for notice to mariners (NTM) requirements. Requirement to notify AHO a minimum of 3 week prior to commencement of the activity information needs to include activity location or area, vessel/rig details including contact details and calls signs, period that NTM will cover (start and finish date). Only need to update AHO if activity start of finish date changes. Do not need to provide cessation notification as long as NTM covers period of activity.	Section 9.7 Ongoing Consultation updated to include AHO requirements.
CFA	18/04/2019	CFA 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Email: Introducing Beach Energy and provision of information on the 'Otway Offshore Project and a summary of Beach's review of Commonwealth fisheries in the project area. A review of the AFMA website identified that the operational area where the drilling activity is planned to occur over the following Commonwealth fisheries: • Eastern Tuna and Billfish Fishery; • Small Pelagic Fishery (Western sub-area); • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors); • Southern Bluefin Tuna Fishery; and • Southern Squid Jig Fishery. However, a review of the ABARES Fishery Status Reports 2014 to 2018 identified that only the following have catch effort within the operational area: • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors); and • Southern Squid Jig Fishery. Information has been provided to AFMA and the following fishing associations: • Scallop Fisherman's Association Inc.; • SIV – SIV have sent out the information sheet attached to their members; • Tuna Australia (ETBF Industry Association); and • SETFIA. The main concerns raised by commercial fishers are sound from the seabed assessment and displacement while the activities occur. Sound from the seabed assessment equipment is of significantly lower intensity than for seismic surveys. Sound modelling identified that the sound threshold level for fish was reached at a maximum distance of 1.6 m from the equipment and did not reach the impact threshold for invertebrates at the seafloor. Drilling at each location will range from 35 to 90 days with fishers not being able to access a 500 m area around the MODU. Thus, the area of displacement is small and not for a significant period of time.	Provision of information. No reply. Drilling at the Artisan-1 well location is expected to take approximately 35-55 days, depending on the final work program and potential operational delays – within the period relayed to CFA.
CFA	10/07/2019	CFA 02	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
CFA	21/04/2020	CFA 11	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
CFA	08/05/2020	CFA 12	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
CFA	10/07/2020	CFA 17 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Commercial Rock Lobster and Crab Fisher	17/04/2019	CRLF 01	Commercial Rock Lobster and Crab Fisher rang as fishes around the Thylacine platform and in that region. He is concerned about the impact on his fishing during drilling as he fishes in the 40-50 fathoms (73 – 91) region in the deeper water west of the platform. Is often there around January to February. He stops fishing in mid-September (when the rock lobster season ends). The season re-starts on 15th Nov. Beach explained that for the seabed assessments the vessel will be moving around and won't be in a particular area for very long. Beach can engage with him at the time and tell him the vessels location and where we are going to be so we can work around one another. Stakeholder is more concerned around the drill periods because we will be in the one spot for longer and he thinks the exclusion zone will be a few kilometres. Would like to meet with Beach to show where he fishes. Beach said there was time to catch up as the seabed assessments won't start before September and drilling until December.	Stakeholder raised concerns about impacts from exclusion to his fishing areas specifically in relation to drilling due to the period when he fishes (January and February and again starting 15th Nov. This period coincides with the proposed drilling activity.
Commercial Rock Lobster and Crab Fisher	18/04/2019 21/04/2019	CRLF 02 CRLF 03	Phones calls to arrange for Beach FLO to meet with stakeholder.	See Stakeholder Record CRLF 05

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Commercial Rock Lobster and Crab Fisher	24/04/2019	CRLF 04	Meeting with FLO and stakeholder. Stakeholder and FLO covered Mapping of fishing grounds and seasonal pattern compared with planned works and transit routes by support vessels, displacement and financial loss concerns, neighbouring works by Cooper Energy, exclusion and advisory clearance zones, other fishing operators in area.	See Stakeholder Record CRLF 05 and 06 of letter to stakeholder of record of meeting and details of Beach's arrangements to manage impact to stakeholder to ALARP and an acceptable level.
Commercial Rock Lobster and Crab Fisher	09/05/2019	CRLF 05 CRLF 06	Letter from Beach to stakeholder detailing: • Beach's confidentiality/privacy policy. • That in future any coordinates supplied would be expressed in degrees and decimal minutes referenced to the WGS 84 datum, so they can immediately be entered on your GPS plotter. • When Beach activities plotted over the locations the stakeholder fished there is potential for interaction between Thylacine and La Bella. • In order to minimise impacts to your fishing, Beach will let fishers know expected timings and more precise location coordinates closer to the start of each activity and will also update fishers on a regular (possibly daily) basis of project status and vessel movement. • Beach's aim is to work together to minimise impacts on each other's operational plans, however, should you or any fisher wish to make a claim for loss as a result of our activities to contact Beach – contact details provided. • Beach would validate that the fisher regularly works in that area as well as evidence of the additional costs they have incurred or the loss they have suffered. Beach will then work with them to validate the claim and assess any compensation required. Validation procedures will necessarily involve access to fishing records and other relevant information. • Beach are aware of the issue you raised regarding your colleague's engagement with another Oil & Gas Company's vessel. When our project becomes operational Beach will undertake discussions with our vessel masters so that impacts on fishing and vice versa are as low as reasonably practicable. Beach's FLO will contact you shortly to discuss access to your fishing data and confirm that you would like to be included on our updates about the location of our activities while we are operational.	Beach aims to undertake the activity in a manner that does not unduly impact on fishers. This EP has been updated in response to the claims from this stakeholder as per the following: • Table 9-3 Ongoing stakeholder consultation requirements updated to note that for notifications to stakeholder where coordinates are supplied coordinates are to be expressed in degrees and decimal minutes referenced to the WGS 84 datum. • Stakeholder provided with Beach contact person should they wish to make a claim for loss as a result of Beach's activities. How Beach will deal with any claims is details in Section 9.3.1 Fishery specific consultation approach and was provided to stakeholder as part of the Beach's Commercial Fisher Operating Protocol (Stakeholder Record CRFL 08 – 09). • Section 8.6 Personnel, Competence, Training and Behaviours updated to include requirements for interactions with fishers and/or fishing equipment in the activity induction that will be required to be undertaken by all vessel personnel. • Engagement will be ongoing with stakeholder to ensure any impacts can be management to ALARP and an acceptable level.

Commercial Rock Lobster and Crab Fisher	09/06/2019	CRLF 07	Meeting between stakeholder and FLO regarding seabed assessments and drilling to ascertain potential impacts and mitigations.
			Fisher discussed fishing pattern and the ability to work around Beach's operations in the area, noting the duration of assessment and drilling events.
			• Real time on water communications between project vessels and fisher best way to avoid adverse incidents as opposed to SMS message service. Stakeholder happy to receive text messages.
			• FLO informed stakeholder that due to anchors and cables around well site during drilling a 2 km cautionary zone shall be established in addition to the 500 m rig safety zone.
			• Stakeholder advised that timing the occurrence of drilling operations when fisher is not in these locations would be ideal.
			• The undertaking by Beach (9 May 2019) that fishers may claim for any validated loss was noted as was confidentiality of catch and effort information.
			• Advance notice of drilling: it takes up to a week to harvest from the reefs and so given the short duration of fishers need for access, advance notice of drilling will provide the opportunity to catch the annual harvest before drilling commences on these fields.
				Beach aims to undertake the activity in a manner that does not unduly impact on fishers. This EP has been updated in response to the claims from this stakeholder as per the following:
				• Table 9-3 Ongoing stakeholder consultation requirements updated to note that for notifications to AHO to issue NTM will specifically include:
				  ○ geographical coordinates of the well location; and
				  ○ the 500 m rig safety exclusion zone & 2 km cautionary zone and requested clearance from other vessels
				• Stakeholder provided with Beach contact person should they wish to make a claim for loss as a result of Beach's activities. How Beach will deal with any claims is details in Section 9.3.1 Fishery specific consultation approach and was provided to stakeholder as part of the Beach's Commercial Fisher Operating Protocol (Stakeholder Record CRFL 08 – 09.
				• Stakeholder advised to contact channel 16 if they wish to communicate with the rig at any time. Rig will be stationary until moved to next location.
				• Rescheduling drilling operations to avoid times when fisher may be in the area is not a practicable option for the drilling program given the long lead times and detailed planning required to undertake the drilling activity. Stakeholder has the ability to fish in broader area irrespective of drilling activity.

Commercial Rock Lobster and Crab Fisher	02/07/2019	CRLF 08 - 09 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience.	Provision of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			This email was follow-up with a phone call from Beach in relation to the seabed assessment areas. No issues were raised by the stakeholder in relation the drilling program.	
Commercial Rock Lobster and Crab Fisher	10/07/2019	CRLF 13	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Commercial Rock Lobster and Crab Fisher	21/04/2020	CRLF 22	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Commercial Rock Lobster and Crab Fisher	08/05/2020	CRLF 23	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Commercial Rock Lobster and Crab Fisher	10/07/2020	CRLF 24 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	
Commercial Shark and Lobster Fisher	28/04/2019	CSF 01	Stakeholder rang Beach 1800 number from Beach's Otway Offshore Program 2019 2pp Info Sheet. Stakeholder confirmed they were aware of Beach's upcoming activities. Fisher raised that a boat operating in the Otway area that had asked a shark fisher to pull his nets last week.	Beach provided information to the stakeholder in relation to the vessel that was not a Beach vessel. See Stakeholder Record CSF 02.
Commercial Shark and Lobster Fisher	29/04/2019	CSF 02	Beach called stakeholder to provide an update on their comments about a boat operating in the Otway area that had asked a shark fisher to pull his nets last week. Beach informed stakeholder that Beach's vessel has not been operating in the region since April 15 and is now located near Wilson's Promontory. Another vessel was operating in the area but was not chartered by Beach. Beach informed stakeholder they had asked their Fisheries Liaison Officer (FLO) to meet with them to understand their fishing patterns and how they may overlap with Beach's proposed activities. Beach can't confirm specific locations and times as yet, but it will be helpful to understand where they fish and when. Stakeholder was comfortable with this as knew the FLO and had met with them before. FLO expected to be able to contact stakeholder by the end of this week (May 3).	Claim in relation to issue with boat operating in the Otway area was not relevant to Beach's activities. See Stakeholder Record CSF 05 for meeting details.
Commercial Shark and Lobster Fisher	30/04/2019	CSF 03 CSF 04	Meeting coordinated between stakeholder and FLO for 3/05/2019.	See Stakeholder Record CSF 05.
Commercial Shark and Lobster Fisher	3/05/2019	CSF 05	Meeting with FLO and stakeholder. Stakeholder concern is that Beach's activities would limit access to where he fishes and cause financial loss. If Beach wanted him to shift his fishing activities, Beach should pay him and he would stay out of their way. FLO explained that both Beach's and fishing activities across the same area was legal and that each were obliged under the Offshore Petroleum and Greenhouse Gas Storage Act 2006, to reduce their impact on each other to as low as reasonable practicable. Stakeholder said that to work around each other; good on water communications between his vessel and project vessels, and a common understanding of mandatory exclusion zones and advisory clearance distances around sites was needed. These were sometimes confused by support vessel masters and caused unnecessary displacement of fishing activities. Stakeholder asked does Beach have any arrangements so that he could claim and evidence a loss if that happened? The map in the information he received (BE_OFFSHORE Project 2pp_March_2019) showed the footprint of Beach's proposed work sites across the project lifetime, reference about the duration at each site and a preliminary calendar of events. More precise detail on start-up timing for each site would enable fisher to better assess likely impacts and fishing options at the time the work is taking place. An image of fisher's activities was provided to Beach.	See Stakeholder Record CSF 07 and 08 of letter to stakeholder of record of meeting and details of Beach's arrangements to manage impact to stakeholder to ALARP and an acceptable level.
Commercial Shark and Lobster Fisher	3/05/2019	CSF 06	Stakeholder provided information to Beach in relation to the Electronic Catch Log System	NA

Commercial Shark and Lobster Fisher	10/05/2019	CSF 07
		CSF 08
			Letter from Beach to stakeholder detailing:
			• Beach's confidentiality/privacy policy.
			• That in future any coordinates supplied would be expressed in degrees and decimal minutes referenced to the WGS 84 datum, so they can immediately be entered on your GPS plotter.
			• When Beach activities plotted over the locations the stakeholder fished there is potential for interaction.
			• In order to minimise impacts to your fishing, Beach will let fishers know expected timings and more precise location coordinates closer to the start of each activity and will also update fishers on a regular (possibly daily) basis of project status and vessel movement.
			• Beach's aim is to work together to minimise impacts on each other's operational plans, however, should you or any fisher wish to make a claim for loss as a result of our activities to contact Beach – contact details provided.
			• Beach would validate that the fisher regularly works in that area as well as evidence of the additional costs they have incurred or the loss they have suffered. Beach will then work with them to validate the claim and assess any compensation required. Validation procedures will necessarily involve access to fishing records and other relevant information.
				Beach aims to undertake the activity in a manner that does not unduly impact on fishers. This EP has been updated in response to the claims from this stakeholder as per the following:
				• Table 9-3 Ongoing stakeholder consultation requirements updated to note that for notifications to stakeholder where coordinates are supplied coordinates are to be expressed in degrees and decimal minutes referenced to the WGS 84 datum.
				• Table 9-3 Ongoing stakeholder consultation requirements updated to note that for notifications to AHO to issue NTM will specifically include:
				  ○ geographical coordinates of the well location; and
				  ○ the 500 m rig safety exclusion zone & 2 km cautionary zone and requested clearance from other vessels

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			• Beach are aware of the issue you raised regarding your colleague's engagement with another Oil & Gas Company's vessel. When our project becomes operational Beach will undertake discussions with our vessel masters so that impacts on fishing and vice versa are as low as reasonably practicable. Transit routes between project sites and Portland are unlikely as our vessel will not be stationed there. • Beach's FLO will contact you shortly to discuss access to your fishing data and confirm that you would like to be included on our updates about the location of our activities while we are operational.	• Stakeholder provided with Beach contact person should they wish to make a claim for loss as a result of Beach's activities. How Beach will deal with any claims is details in Section 9.3.1 Fishery specific consultation approach and was provided to stakeholder as part of the Beach's Commercial Fisher Operating Protocol (Stakeholder Record CSF 10 -11). • Section 8.6 Personnel, Competence, Training and Behaviours updated to include requirements for interactions with fishers and/or fishing equipment in the activity induction that will be required to be undertaken by all vessel personnel. • Engagement will be ongoing with stakeholder to ensure any impacts can be management to ALARP and an acceptable level.
Commercial Shark and Lobster Fisher	09/06/2019	CSF 09	Meeting between stakeholder and FLO regarding seabed assessments and drilling to ascertain potential impacts and mitigations. Fisher discussed fishing pattern and the ability to work around Beach's operations in the area, noting the duration of assessment and drilling events. Stakeholder informed FLO shark mesh netting favours smooth seafloor i.e., where drilling likely to occur. The general pattern has been to fish in between Warrnambool and Port Campbell in the summer in 35 fathoms (64 m) depth and shallower. Other areas are targeted later in the year, for example in waters of 70-80 fathoms (128 – 146 m) between western Victoria and the south east of South Australia. FLO informed stakeholder that due to anchors and cables around well site during drilling a 2 km cautionary zone shall be established in addition to the 500 m rig safety zone. Stakeholder advised FLO an estimated 80% of a stakeholder's trip consists of shortened duration "try" shots until higher catches were found. Fishers concern was if higher catches were found that continued targeting of the aggregation might be blocked by one of Beach's operations and cause an adverse financial result. In discussion with FLO it was recognised that the spatial constraints on Beach in the Otway Basin area were more than that of shark fishers. Whether or not an aggregation of shark continued on the other side of one of Beach's operations could not be determined until the event, however correspondence from Beach on 10 May 2019 that said fishers may claim for any validated loss was noted. Stakeholder advised FLO there would be some difficulty receiving texts advising of operational plans as the fishing vessel's phone did not take texts. Communications are usually achieved via "Messenger" to skippers personal phone. Sometimes it is possible to talk if in range, but the reach of "Messenger" is beyond that of talk on this service. For real time on-water communications, FLO advised stakeholder to call up on Ch 16 HF then go to a nominated working channel or with phone range ring up either of the numbers provided.	Beach aims to undertake the activity in a manner that does not unduly impact on fishers. This EP has been updated in response to the claims from this stakeholder as per the following: • Table 9-3 Ongoing stakeholder consultation requirements updated to note that for notifications to AHO to issue NTM will specifically include: o geographical coordinates of the well location; and o the 500 m rig safety exclusion zone & 2 km cautionary zone and requested clearance from other vessels • Stakeholder provided with Beach contact person should they wish to make a claim for loss as a result of Beach's activities. How Beach will deal with any claims is details in Section 9.3.1 Fishery specific consultation approach and was provided to stakeholder as part of the Beach's Commercial Fisher Operating Protocol (Stakeholder Record CSF 10 -11). • Stakeholder advised to contact channel 16 if they wish to communicate with the rig at any time. Rig will be stationary until moved to next location. As per Beach's Commercial Fisher Operating Protocol Beach will provide SMS messaging system updates 2 days prior to the rig moving to a new location detailing the new location and the expected duration at the location so Fishers can plan their fishing activities with the least disruption. The area where the stakeholder fishes, between Warrnambool and Port Campbell in the summer in 35 fathoms (64 m) depth and shallower, does not overlap the Artisan-1 well location which is in water depths approx. 71 m. During winter the stakeholder fishes between western Victoria and the south east of South Australia.
Commercial Shark and Lobster Fisher	2/07/2019	CSF 10 - 11 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. This email was follow-up with a phone call from Beach in relation to the seabed assessment areas. Stakeholder referred to Beach activities in depths shoreward of Geographe as having the potential to affect his shark fishing activities, but this can only be dealt with at the time, when and if he is following a trend in shark abundance and that should this occur he would be in touch for relevant discussions.	Provision of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. The area where the stakeholder fishers are unlikely to overlap the drilling location.
Commercial Shark and Lobster Fisher	10/07/2019	CSF 15	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	
Commercial Shark and Lobster Fisher	21/04/2020	CSF 25	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Commercial Shark and Lobster Fisher	08/05/2020	CSF 26	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Commercial Shark and Lobster Fisher	10/07/2020	CSF 27 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Corporate Alliance Enterprises	09/04/2019	CAE 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
		Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	
Corporate Alliance Enterprises	07/06/2019	CAE 02 OPOG19IS#1 & OPOG19IS#2	Beach email to CAE: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us.	Provision of information.
Corporate Alliance Enterprises	02/07/2019	CAE 03 OPOG19IS#1 & OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Commonwealth Department of Environment and Energy – Director of National Parks	23/09/2019 23/10/2019	DOEE 01 DOEE 02	Beach email: Introduction to Beach Energy. Information provided regarding worst case hydrocarbon discharge scenarios for proposed activities in the Otway Basin incorporating tables outlining environment potentially exposure to low in-water thresholds from both a hypothetical diesel release from Artisan-1 well location and condensate release from Artisan-1 well location to Australian Marin Parks. Beach provide offer to supply any additional information upon request. Beach sought feedback on the above information and any potential controls required regarding hydrocarbon spill monitoring and/or notification protocols/contact details. Email received from DOEE confirming: Correct contact for these emails. Noted potential impacts of unplanned activities. Referenced guidance notes available for marine parks. "I can confirm that we do not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with a marine park or new impact, or for emergency responses"	Provision of information and clarification. No additional information required. DAWE to be notified in the instance of an overlap with a marine park or new impact, or for emergency responses.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	26/04/2019 18/04/2019	DJPR-ERR 01 DJPR-ERR 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	02/07/2019	DJPR-ERR 03 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	10/07/2019	DJPR-ERR 04 DJPR-ERR 05 DJPR-ERR 06	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	21/04/2020	ERR 19	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	08/05/2020	ERR 20	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Department of Jobs, Precincts and Regions (DJPR): Earth Resources Regulation	10/07/2020	ERR 25 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	03/04/2019 – 03/05/2019	DJPR MP 01 DJPR MP 02 DJPR MP 03 DJPR MP 04	Meeting and OPEP assessment coordination between Beach and DJPR	See record DJPR MP 05
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	09/05/2019 & 13/05/2019	DJPR MP 05 DJPR MP 06 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1	Beach email following meeting held between Beach and DJPR: As discussed, we are planning to commence petroleum activities in Commonwealth waters from August/September this year with the drilling rig arriving in December 2019 (subject to regulatory approvals). I have attached an electronic copy of the information sheet provided at the meeting which includes a project timeline. Some of the key points from the meeting from our perspective are as follows: - DJPR Emergency Management Branch (EMB) Incident notification and contact email marine.pollution@ecodev.vic.gov.au and 24h phone is 0409 858 715 - Incident management room email semdincidentroom@ecodev.vic.gov.au - DJPR planning to consult with industry on a draft guidance note after Spillcon - DJPR EMB prefer to receive OPEPs prior to submission to NOPSEMA and will coordinate a response on behalf of government - Beach to provide a draft of the revised Otway OPEP for review this week with the aim of receiving comments from DJPR by 31 May - DJPR would like to participate in a Beach exercise with State content - Beach's incident management team based on an AIIMS structure - Beach are willing to participate or observe a State based training exercise coordinated by Victorian government - Beach have contracted the Diamond Ocean Onyx MODU which is to be dry towed from Singapore and offloaded in Pt Phillip Bay. DJPR interested in how biosecurity of the rig will be managed in particular biofouling. Let me know if you have any further comments.	Provision of information Beach have included DJPR EMB contact details within OPEP. Beach have committed to provide EMLO familiar with AIIMS structure to interface with DJPR in the event of a marine pollution incident. Beach provided a copy of draft OPEP to DJPR for coordination of State review (see DJPR MP 07). Biosecurity (including biofouling) managed by: • the Diamond Ocean Onyx MODU being dry-docked and cleaned and inspected in Singapore; • the Diamond Ocean Onyx MODU will be dry-towed to Australian Commonwealth / State waters, removing the potential for in-transit biofouling to occur; • Diamond Offshore to adhere to Australian Ballast Water Management Requirements Rev 7; and • Diamond Offshore to obtain Department of Agriculture clearance to enter Australian waters.
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	21/05/2019	DJPR MP 07 DJPR MP 08	Beach email providing copy of updated Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) Rev D to DJPR for coordination of Vic State review. Beach requested response by 11th June 2019.	Provision of information.
Department of Jobs, Precincts	07/06/2019	DJPR MP 09	The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including exclusion	Provision of information

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
and Regions (DJPR): Marine Pollution		DJPR MP 10 OPOG19IS#1 & OPOG19IS#2	zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. Unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us.	
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	09/06/2019 – 11/06/2019	DJPR MP 11 DJPR MP 12 DJPR MP 13	OPEP assessment coordination between Beach and DJPR.	See record DJPR MP 14
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	13/06/2019	DJPR MP 14 DJPR MP 15	DJPR provided consolidated comments on Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) Rev D received from: • DELWP • DJPR ERR • DJPR Emergency Management Branch • EPA • Parks Victoria Comments received related to: State expectations for joint industry and State oil spill response based upon draft guidance (yet to be published by DJPR); updated contact information; scientific monitoring requirements; and oiled wildlife response arrangements. Beach confirmed comments received and OPEP would be amended as required.	All comments received from Victorian State government (via coordinated review) have been incorporated into the subsequent revision of the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) prior to submission to NOPSEMA for assessment.
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	10/07/2019	DJPR MP 16 DJPR MP 17	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Department of Jobs, Precincts and Regions (DJPR): Marine Pollution	26/09/2019	DJPR MP 18	Beach email: regarding worst case hydrocarbon discharge scenarios for proposed activities in the Otway Basin incorporating tables outlining environment potentially exposure to low in-water thresholds from both a hypothetical diesel release from Artisan-1 well location and condensate release from Artisan-1 well location. Beach provide offer to supply any additional information upon request. Beach sought feedback on the above information and any potential controls required regarding hydrocarbon spill monitoring and/or notification protocols.	Provision of information and clarification. No response received from DJPR to date.
Department of Jobs, Precincts and Regions (DJPR): Victorian Gas Project	07/06/2019	VGP 01 VGP 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 & OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	We would like to inform you that we're planning further development of our Otway offshore natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The project is expected to start around September 2019, depending on regulatory approvals, weather windows and availability of contractors. Please find attached an information sheet summarising details on the project. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at https://www.beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link.	Provision of information

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			In preparation of our Environment Plans we are keen to understand if you have any questions, concerns or feedback or require any further consultation on the above projects. Please don't hesitate to contact us.	
3D Oil	02/08/2019	3D 01	Email received: This notice refers to the 3D Oil Dorrigo 3D Marine Seismic Survey, planned for West of King Island. We wish to inform all stakeholders that The Dorrigo project will not proceed during 2019. 3D Oil intends to delay the activity to 2020. 3D Oil will endeavour to notify stakeholders as plans develop. 3D Oil adopts the following standard notifications timeframes for stakeholders, unless stakeholders have specific notification requirements: • At any changes to the activity plan or scope; • At least one month prior to planned survey commencement; • At least five days prior to survey equipment deployment; • At the commencement of survey acquisition activities; and • Within 10 days of survey completion. 3D Oil would like to thank all stakeholders that have provided feedback for the Dorrigo Project. If you would like to provide additional comment, please contact us on the details below.	Information received. No control required given the proposed Dorrigo 3D Marine Seismic Survey acquisition area is over 60 km from the Artisan-1 well location.
Otway Gas Plant Community Reference Group	18/04/2019	CRG 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1& Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Otway Gas Plant Community Reference Group	26/06/2019	CRG 02 OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	At CRG meeting 2019 Beach provided an update on all projects, including the offshore project. Also provided to members the long information sheet. • Engagement with all stakeholders undertaken and ongoing. • Direct engagement with fishing sector undertaken and ongoing. • Awaiting project approvals before confirming dates.	Provision of information.
Portland Professional Fishermen's Association	17/04/2019	PPFA 01 PPFA 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1& Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Portland Professional Fishermen's Association	10/07/2019	PPFA 03	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information
Portland Professional Fishermen's Association	21/04/2020	PPFA 16	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
Portland Professional Fishermen's Association	08/05/2020	PPFA 17	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Portland Professional Fishermen's Association	10/07/2020	PPFA 18 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Schlumberger	18/10/2019	SLB 15	Update received from Schlumberger regarding Otway Basin 2DMC Seismic survey ingress agreement informing Beach of a potential November 2019 commencement of activities.	Information received. No control required in relation to Artisan-1 exploration drilling as 2DMC Seismic survey is approximately 17 km from the Artisan-1 well location and commencement date earlier than proposed drilling of Artisan-1 well.
SIV	19/02/2019	SIV 01 OP19IS#1 - Otway Offshore Program 2019	Beach and SIV meeting. Beach presented 2-page information on the upcoming Otway Offshore Project. Beach explained there would be a seabed assessment phase commencing in approx. September 2019 followed by a drilling phase which was expected to commence towards the end of the year and continue for approx. 18 months. Beach showed map to SIV and discussed locations.	Provision of information and agreement to send information to SIV members via SIV.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
		2pp Info Sheet #1 and Otway Offshore Map Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach asked what SIV's preferred way to consult with fishers was. SIV said if Beach provided the Information sheet SIV would arrange for it to be mailed to SIV members, under a cover letter. The letter would ask fishers who were affected or required further consultation to respond within 2 weeks so SIV can validate that they fish in the area and allow Beach to respond to any questions.	
SIV	07/03/2019	SIV 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email of discussion at meeting held on the 19/02/2019 in relation to Beach's upcoming Offshore campaign. Beach presented a 2-page information on the upcoming Otway Offshore Project and explained there would be a seabed assessment phase commencing in approx. September 2019 followed by a drilling phase which was expected to commence towards the end of the year and continue for approx. 18 months. Map was shown and briefly discussed locations. Beach asked what SIV's preferred way to consult with fishers was. SIV said if Beach provided the Information sheet, they would arrange for it to be mailed to SIV members with a cover letter. SIV stated they would ask fishers who were affected or required further consultation to respond within 2 weeks so SIV can validate that they fish in the area and allow Beach to respond to any questions. Agreed that SIV would do a mailout of the attached 2-page information sheet and cover letter to SIV members. Beach provided 2-page information sheet and requested that cover letter ask fishers to contact Beach if they fish in the areas where we will be operating. Also, to let them know that further information will be available on our website at beachenergy.com.au/vic-otway-basin/. SIV recommenced two weeks for fishers to respond. Asked to review SIV cover letter prior to mailout.	Provision of information to SIV for mail out to members.
SIV	19/03/2019	SIV 03 SIV 04	SIV provided cover letter for Beach to review. Beach provided feedback on letter and asked to add a comment about 2 weeks to respond. Also requested to hold off mail out as information sheet was being updated.	Provision of information to SIV for mail out to members.
SIV	19/03/2019	SIV 05 SIV 06	SIV reply: will include a comment about the 2 weeks but need to know when we are sending. SIV concern about two weeks and putting a specific timeframe on it is that this needs to be an open communication and ongoing consultation - it does not just stop. But we also have 3 other consultation processes going on - so if possible, for more time, then this will be crucial. Beach reply: We also expect the consultation to be open and ongoing. The 2-week timeframe is to allow us to get initial feedback and understand who may be fishing in the areas so that if we need to undertake more specific consultation with them, we understand who they are. We will provide further information closer to the time of the seabed assessments and again prior to commencing drilling. And of course, we will consult with any fisher that requires it during the life of the project.	Two-week timeframe is to allow for initial feedback and understand who may be fishing in the areas so that if required more specific consultation can be undertaken. Beach agrees that stakeholder consultation will be ongoing and stakeholders any issues or concerns raised prior or during the activity will be addressed as per Section 9.7. EP Section 9.7 details ongoing stakeholder engagement for the activity.
SIV	22/03/2019	SIV 07	Beach update on status of the information sheet.	Provision of information to SIV for mail out to members.
SIV	27/03/2019	SIV 08	Beach call to provide update on status of information sheet and also that there were now some additional survey areas, which were for potential tie-ins of wells to the seabed pipeline. SIV asked what this would cover - was VSP included? Beach said the surveys would use equipment such as echo sounders, may take seabed grabs and take core samples 6m below the seabed surface. VSP was not included in these surveys. Beach asked if Beach needed to separately email the information sheet to VRLA, Port Campbell Professional Fishers Association or similar organisations. SIV confirmed that they will handle this engagement.	Drilling activity does not include vertical seismic profiling (VSP).
SIV	27/03/2019	SIV 09	Beach email to confirm delivery of the information sheets and if in the cover letter you can ask members to let us know if they want further consultation or fish in the affected area by 19th April. We will continue engagement after that time, but we'd like to understand who specifically may be impacted or has concerns so we can plan further engagement with them, and SIV.	Provision of information to SIV for mail out to members.
SIV	28/03/2019	SIV 10 SIV 11 SIV 12	Organisation of information sheet for mail out to SIV members.	Provision of information to SIV for mail out to members.
SIV	29/03/2019	SIV 14 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1	Letter and information sheet sent to approximately 300 SIV members. Dear Victorian Licence Holder and Operators RE: UPCOMING BEACH ENERGY OFFSHORE PROJECTS	Provision of information to SIV for mail out to members.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
		Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	I am writing to you regarding recent discussions between SIV and Beach Energy regarding a proposed Seabed Assessment and Drilling Program from 2019 – 2021. Beach Energy have provided SIV with the attached 2-page information sheet which provides detailed information on the activities proposed, the areas they intend to operate and timeframes for the proposed works. There is also further information available at: www.beachenergy.com.au/vic-otway-basin/. Beach Energy have sought SIV to correspond with you to seek your views and issues on the proposed areas, and their interaction with areas in which you operate. If you have any concerns, questions, comments or seek any further information please contact Beach Energy at community@beachenergy.com.au by the 19th April. Alternatively let us know at SIV and we can pass your comments through to Beach Energy. Thank you for your time reading and understanding this information and please do not hesitate to contact me if there are any queries.	
SIV	2/04/2019	SIV 15 SIV 16	Emails between Beach and SIV confirming mail out sent.	NA
SIV	16/04/2019	SIV 17	Beach phone call to see if any response to member mail out. Four fishers have stated they would be fishing out deeper this year, as a result of discussions in the quota meetings held recently. Can Beach provide information on where and when they will be operating? Beach replied it is too early for this information to be available, it will not be available until closer to the time of the activities. Seabed assessments will be undertaken in September and again in about March, with drilling scheduled to commence in December. Are fishers able to inform us of their plans so we can feed that into our planning – it may not be able to be considered but it's good to know so we are aware. SIV replied that could be arranged. The purpose of sending out the flyer was so we can work together, so this is what we expected. Beach - we would expect that, closer to the time, we would send the interested fishers text messages of where our activities are occurring on a regular basis. SIV – I'll discuss with them and come back to you with their plans.	Four fishers had contacted SIV in relation to the information sheet mail-out. These fishers will be fishing deeper this year and seek further information regarding location and timings. Beach met with SIV 3/05/2019 Record VFA 25 to further discuss Beach's activities. Beach will continue ongoing engagement with SIV and any affected fishers as per Section 9.7.1 Fishery specific consultation approach to ensure impacts to fishers are ALARP and an acceptable level.
SIV	29/04/2019 01/5/2019	SIV18 – SIV 21	Emails to obtain copy of cover letter sent to SIV members.	NA
SIV	03/05/2019	VFA 25	Meeting between Beach, VFA and SIV. Beach provided VFA with an extract of the current draft of the Seabed Assessment EP chapters related to noise modelling and the identification of fisheries. Beach stepped VFA through the noise modelling at a high level and the conclusions that there was no unacceptable impact to marine fauna. VFA said it was good to have the report and that they would review it in more detail. Beach explained the consultation approach with fishers; engagement had been via SIV who undertook a mailout of a 2-page information sheet (which had also been provided to VFA) to their approx. 300 members. A cover letter had asked for fishers to identify if they felt they would be impacted by the activities. SIV had reported that 4 fishers had come forward and 2 others had contacted Beach directly. Beach will engage with these fishers and SIV as part of on-going consultation and specifically when details of the exact locations and timing of the seabed assessments and drilling were available. Beach would also provide regular/ daily information on the location of vessels and MODUs to those who wanted to receive that information. VFA was comfortable with this approach. VFA asked about any permanent restrictions on fishing grounds, such as permanent exclusion zones, as this would reduce the available area for fishing. Beach explained that there may be a requirement for some wells to have exclusion zones around the infrastructure that will be installed on the seabed. At this stage the requirements for which wells and any details of the exclusion zones were not yet known. SIV joined the meeting and Beach gave a recap on the consultation that had been undertaken with commercial fishers. SIV was also provided with a copy of the draft Seabed Assessment EP extract. SIV informed VFA that they were happy with the way that Beach had undertaken the consultation and their plans for on-going consultation. Beach discussed with SIV a time when they could catch up to discuss the impacts on the four fishers that had identified themselves but no date was chosen due to current availability. SIV and VFA reviewed the fishing effort maps in the draft Seabed Assessment EP extract and queried the fishing activity for the giant crab map, in the grids located close to shore. Beach informed that the data had been provided by VFA.	Whilst Beach provided SIV with an extract of the current draft of the Seabed Assessment EP chapters related to noise modelling and the identification of fisheries, the provision of this information was not relevant to the scope of the Artisan-1 drilling EP. Beach will continue ongoing engagement with SIV and any affected fishers as per Section 9.7.1 Fishery specific consultation approach to ensure impacts to fishers are ALARP and an acceptable level. Beach has engaged directly with the fishers that contacted them. See Records for CRLF and CSF. VFA had raised concerns about loss of fishing area from permanent exclusion zones. During drilling activities, a temporary 500 m rig safety zone will be established, coinciding with the activity timing and duration (approximately 35-55days). Additionally, a 2 km cautionary zone will be relayed to fishers via the AHO NTM process. Upon completion of the drilling activity, the Artisan-1 well is to be plugged and abandoned, unless the well has been assessed as viable for future production. Should Artisan-1 well be assessed as viable for future production, the well will be suspended, and a permanent PSZ will be established around the well location. Updated rock lobster and giant crab fishery maps were sent to VFA and SIV. See Record SIV 22 and VFA 27.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
SIV	10/05/2019	SIV 22 – see VFA 27 for email record. SIV 23	Beach email providing updated information as discussed at meeting on 3/5/2019 Record VFA 25. In the extract of the Seabed Assessment EP Beach provided VFA and SIV commented on the fishing effort maps. Beach have reviewed the maps we discussed and are including revised versions in the EP we are submitting shortly. The updated maps were provided which show only the areas where there has been catch effort for rock lobsters and giant crabs within the seabed survey operational area. We have also firmed up the sizes of the seabed assessment survey areas which vary slightly to what was communicated in the Otway Offshore Information Sheet we published. The revised areas were provided. Don' hesitate to let me know if you have any questions. I will contact you next week about setting up a time to meet to discuss in more detail the program and the impacts on the fishers who have come forward as fishing in the area.	Updated rock lobster and giant crab fishery maps showing overlap of fishery effort with the operational area that are presented in this EP where provided to SIV and VFA. All matters relating to the intersection of commercial fisheries and survey locations have been addressed within the Site Survey EP and are not relevant to the drilling activity. Meeting will be set up with SIV to discuss the fishing effort of the four fishers who have raised with SIV that they fish in the area. Beach will continue ongoing engagement with SIV and any affected fishers as per Section 9.7.1 Fishery specific consultation approach to ensure impacts to fishers are ALARP and an acceptable level.
SIV	21/05/2019 – 11/06/2019	SIV 24 SIV 25 SIV 26	Emails and phone communications between Beach and SIV to arrange meetings to discuss ongoing fisher engagement for the offshore program and confirm Fisher activity within the area. Meeting arranged for the 11/06/2019 and subsequently rescheduled for 13/06/2019.	NA
SIV	12/06/2019	SIV 27 OPOG19IS#1 & OPOG19IS#2	Beach email providing two information sheets, one of which included details of proposed drilling locations and timing and raising an agenda for a forthcoming meeting. Agenda items relevant to development drilling included: Ongoing engagement with Fishers during the drilling program including lines of communication and frequency of updates; and The potential establishment of Petroleum Safety Zones for subsea infrastructure.	Provision of information for meeting (Stakeholder Record SIV 28).
SIV	13/06/2019	SIV 28	Phone meeting conducted between Beach and SIV: Beach explained the information sheets (1 for seabed assessments and 1 for drilling) that had been emailed to SIV. SIV informed Beach that information sheets would be distributed to fishers who had come forward and have discussions with them regarding the impacts. Beach noted that two fishers had contacted Beach directly and they had been provided with the information sheets and Beach had met with them to discuss impacts. Names were exchanged so SIV could ensure no overlap with the fishers SIV engaging with. For the drilling program, Beach confirmed a 500 m exclusion zone around the rig, overlaid with a 2 km cautionary zone. Beach committed to ongoing engagement with fishers by providing the location of the rig when it moves and on a regular basis and asked SIV what timing/interval was appropriate. SIV confirmed a weekly update would be appropriate. SIV expects Beach to undertake normal on-water communications as had happened in the past. Beach informed SIV that Artisan, located at depth of approximately 71 m would be the first well to be drilled followed by the Geographe wells. SIV to await fisher's response once information relayed via SIV. Beach informed SIV that when wells were ready for production seabed infrastructure would be installed to tie the well back to the pipeline or Thylacine platform. These will be protected by a Petroleum Special Zone - a 500 m exclusion zone. Beach noted that each zone is approx. 500 m radius and Beach were mapping the potential zones against the various fisheries in the area to see what percentage of the overall fishery is impacted. Beach noted that for Artisan-1 the PSZ would be by itself, the Geographe wells would most likely fit within the existing PSZ and the Thylacine wells are located closer together. SIV deferred discussion relating to PSZ.	Ongoing stakeholder engagement includes weekly updates to fishers on MODU location. During drilling activities, a temporary 500 m rig safety zone will be established, coinciding with the activity timing and duration (approximately 35-55days). Additionally, a 2 km cautionary zone will be relayed to fishers via the AHO NTM process. Upon completion of the drilling activity, the Artisan-1 well is to be plugged and abandoned, unless the well has been assessed as viable for future production. Should Artisan-1 well be assessed as viable for future production, the well will be suspended, and a permanent PSZ will be established around the well location.
SIV	17/06/2019 – 20/06/2019	SIV 29 SIV 30 SIV 31 SIV 32	Series of communication between Beach and SIV regarding four fishers with potential to fish in development area. No contact made to date.	Follow-up.
SIV	28/06/2019	SIV 33	Beach email: Did you get any feedback from the four fishers regarding Beach's Otway Offshore Project? Are you able to tell me what type of fishing they do – all rock lobster and giant crab or do they fish for other species too?	Follow-up.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
SIV	02/07/2019	SIV 34 - 35	SIV email: They hold multiple licences, so unsure of which species they are fishing in these Areas. Haven't heard yet, shall follow up today. Beach: Thanks.	Follow-up.
SIV	02/07/2019	SIV 36 - 37	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
SIV	09/07/2019	SIV 39	Beach email: Our EP for the Artisan Exploration well is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, don't hesitate to contact me if you have any questions. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
SIV	21/04/2020	SIV 63	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
SIV	08/05/2020	SIV 64	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
SIV	10/07/2020	SIV 70 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA:	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	17/04/2019	SETFIA, SSIA, SPF 01 SETFIA, SSIA, SPF 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. Can you confirm that you are representing SETFIA, SSIA and Small Pelagic Fishery? I would also like to discuss with you whether you would like us to engage with any of members of the associations you represent and will call you tomorrow to discuss this. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	18/04/2019	SETFIA, SSIA, SPF 03 SETFIA, SSIA, SPF 04	Follow-up phone call and email.	No response.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	04/06/2019 – 13/06/2019	SETFIA, SSIA, SPF 05 SETFIA, SSIA, SPF 06 OPOG19IS#1 OPOG19IS#2 SETFIA, SSIA, SPF 07	Follow-up phone call and email. Beach email providing information: The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us.	Provision of information. No response.
SETFIA, SSIA, SPF Stakeholder groups represented by	13/06/2019	SETFIA, SSIA, SPF 08	Email from SETFIA providing SETFIA's approach to consultation document and offer of meeting.	Information received.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Atlantis Fisheries Group				
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	13/06/2019	SETFIA, SSIA, SPF 09 SETFIA, SSIA, SPF 10 SETFIA, SSIA, SPF 11	Phone call between Beach and SETFIA: Beach contacted SETFIA following email in which SETFIA provided SETFIA's approach to consultation. SETFIA explained that considerable amounts of time had been spent consulting on behalf and with Oil & Gas proponents. The SETFIA Board have reviewed this position and they are now resourced to be able to undertake consultation, at the rates shown in the document 'SETFIA Proposal for Oil & Gas coys 28 May 2019_Gas Image'. SETFIA noted that Beach activities would not cover the Eastern Zone or Scallop fisheries. SETFIA asked whether Beach has obtained the data on the Commonwealth fisheries within the area. Beach explained that necessary (available) Commonwealth data had been obtained and the Victorian fishery data that had been obtained. SETFIA expanded on SETFIA's consultation approach and all activity after this email would be expected to be chargeable. Email received from SETFIA in follow-up to conversation. SETFIA emphasised importance of obtaining both Commonwealth and State fisheries data. SETFIA could get involved as per our proposal either to interpret data or to obtain the data (Vic and/or C'wealth). SETFIA explained their current workload.	Information provided and received. Appendix B4.8 details the data in relation to the Commonwealth fisheries based on the last 5 years ABAREs Fishery Reports (2014 - 2018) and from AFMA (Stakeholder Record AFMA 02) stating that there were currently no active fishers in the area. Appendix B4.9 details the data in relation to the Victorian fisheries that was obtained from Victorian Fisheries Authority (VFA) (see Stakeholder Records 07 – 12). Beach responded to SETFIA see Stakeholder Record SETFIA, SSIA, SPF 13.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	20/06/2019	SETFIA, SSIA, SPF 12	Beach received email from SETFIA: SETFIA provided Beach with general proposal to maintain service. In order to engage properly we would need to understand the extent of trawling and gillnetting in the area (we have a formal strategic alliance with the gillnet association). As a first step please can you provide us with any data you have about Commonwealth trawl or gillnet effort around your proposed wellheads. We are pleased that you are offering an SMS service.	Information received. Appendix B4.8 details the data in relation to the Commonwealth fisheries based on the last 5 years ABAREs Fishery Reports (2014 - 2018) and from AFMA (Stakeholder Record AFMA 02) stating that there were currently no active fishers in the area. Appendix B4.9 details the data in relation to the Victorian fisheries that was obtained from Victorian Fisheries Authority (VFA) (see Stakeholder Records 07 – 12). Beach responded to SETFIA see Stakeholder Record SETFIA, SSIA, SPF 13.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	21/06/2019	SETFIA, SSIA, SPF 13 OPOG19IS#1 OPOG19IS#2	Beach email to SETFIA: Thank you for your offer of assistance with gathering data, analysis and consultation for Beach's Otway Offshore Project. I've followed up with our team regarding the fishing effort data we have gathered for the Otway Offshore Project. A review of the AFMA website and ABARES reports (2013 – 2017) identified that the following Commonwealth managed fisheries potentially have catch effort over the survey areas. The data from the ABARES report show that it is a low level of fishing, but the data is not granular enough to identify numbers. • Eastern Tuna and Billfish Fishery • Southern and Eastern Scalefish and Shark Fishery • Southern Squid Jig Fishery Could you provide Beach with a quote for you to undertake the following work for Beach: • Confirm the Commonwealth fisheries and level of fishing within the survey areas • Review the attached information sheets regarding the project and let me know of any questions you may have. Further details are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. • Distribute the information sheet (s) to the relevant SETFIA members and collect any questions or feedback from them and pass them to us. • Distribution of SMS messages to the relevant fishers during the seabed assessment phase and the drilling phase, to inform them of the location of our boats and MODU. We have already provided the attached information sheet to the following groups who are relevant to the Commonwealth fisheries: CFA, VFA, SIV who have distributed to their members, Tuna Australia who are the industry association for ETBF and Sustainable Shark Fishing Inc. To date only one shark fishery has contacted Beach.	Provision of information and request for quotation for service to confirm Commonwealth Fisheries and undertake consultation in relation to the Otway Development seabed assessment and drilling program.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			I have also attached two further information sheets that provide more specific data related to the proposed location, duration and sequence of our activities. These will be updated as Beach works to finalise its plans however, they may be useful to the fishers who fish in the area. If you would like to discuss please don't hesitate to call me, else I look forward to receiving your quote.	
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	21/06/2019	SETFIA, SSIA, SPF 14	SETFIA email: The challenge of your proposal is that it is so small that fishery management agencies may not provide us with data because it does not pass their confidentiality hurdles. The Commonwealth only release data for certain numbers of vessels and at a certain scale. SETFIA detailed a proposal to obtain data for the operational area and proposed a fee to obtain the Commonwealth data including: A review of the attached information sheets regarding the project and let me know of any questions you may have. Distribution of the information sheet (s) to the relevant SETFIA and SSIA (the likely affected sectors) members, collection of any questions or feedback. Distribution of SMS messages to the relevant fishers during the seabed assessment phase and the drilling phase, to inform them of the location of our boats and MODU. Given the need to wait for data requests it would take 6-8 weeks from contract execution. I note your plan to start drilling in September.	Due to the timeframe for which the information is required Beach requested the data in relation to Commonwealth fisheries direct from AFMA. Appendix B4.8 details the data in relation to the Commonwealth fisheries based on the last 5 years ABAREs Fishery Reports (2014 - 2018) and from AFMA (Stakeholder Record AFMA 02) stating that there were currently no active fishers in the area.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	21/06/2019	SETFIA, SSIA, SPF 15	Beach email: Thanks for your quote. I've reviewed the proposal with our team and, like you we are concerned that we may not get much more data than we already have. Hence, we would like to focus on the consultation aspect of the quote only. Would you mind providing a revised quote, removing the data gathering and analysis piece but covering: • A review of the attached information sheets regarding the project and let me know of any questions you may have. • Distribution of the information sheet (s) to the relevant SETFIA and SSIA (the likely affected sectors) members, collection of any questions or feedback. • Distribution of SMS messages to the relevant fishers during the seabed assessment phase and the drilling phase, to inform them of the location of our boats and MODU.	Due to the timeframe for which the information is required Beach requested the data in relation to Commonwealth fisheries direct from AFMA. Appendix B4.8 details the data in relation to the Commonwealth fisheries based on the last 5 years ABAREs Fishery Reports (2014 - 2018) and from AFMA (Stakeholder Record AFMA 02) stating that there were currently no active fishers in the area. Beach requested an updated proposal cover the consultation aspects only.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	21/06/2019 24/6/2019 25/06/2019 01/07/2019 02/07/2019	SETFIA, SSIA, SPF 16 - 21	SETFIA email: This is probably wise. You would have got a very large report that made very large assumptions about very little catch. SETFIA and Beach emails in relation to obtaining an updated quote for consultation as detailed in Stakeholder record SETFIA, SSIA, SPF 15.	SETFIA feedback in relation to there being very little catch in the area of the seabed surveys aligns with AFMA's feedback (Stakeholder Record AFMA 02) that there were currently no active Commonwealth fishers in the area.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	02/07/2019	SETFIA, SSIA, SPF 22 OP19-USAIS-P2/7 OPOG19IS#2 OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email: While the paperwork is being done for Beach to engage SETFIA to support our consultation on the Otway Offshore Project, I wanted to send you the latest information on the project. Please see attached for: • The original detailed, information sheet on the Otway Offshore Project. • An updated information sheet showing the proposed locations, durations and sequence of the seabed assessment activity. This replaces the one we sent you on 7 June. Please note the addition of a Geographe West survey area, which will increase the survey period by 5 days. There are also minor changes to the umbilicals stemming from the Artisan and La Bella survey areas. • An information sheet showing the proposed locations, durations and sequence of the drilling program. This is the same as the one we sent you on 7 June, as there is no changes to the locations, duration or sequence of the drilling program. We have also developed a Commercial Fisher Protocol which I have included below, for you use when engaging with SETFIA members. Please let me know if you have any questions or receive any feedback from your members on any aspects of the Otway Offshore Project.	Provision of updated information on the seabed assessment areas and timings as part of ongoing consultation.
SETFIA, SSIA, SPF Stakeholder groups represented by	03/07/2019	SETFIA, SSIA, SPF 23 - 25	Emails between Beach and SETFIA in relation to issue of SETFIA members providing phone numbers to Beach to undertake SMS message due to concerns with privacy.	Ongoing consultation in relation to service SETFIA will provide.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Atlantis Fisheries Group				
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	03/07/2019	SETFIA, SSIA, SPF 26	Beach email: I do understand how important privacy is to fishers. Once your team have contacted your members, we will have a better idea how many people need to be contacted. Given the very low levels of fishing in the region there may be only one or two, or in fact none that need to be kept informed. Like you, we don't want to send messages to people to whom the information is not relevant. In particular, regular messages about the location of a vessel doing seabed assessments will only serve to annoy them, which we want to avoid. When do you think you may know how many, if any, members will want to be kept informed? It may be that, other than yourself, we don't need to keep any of your members up to date.	Ongoing consultation in relation to service SETFIA will provide.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	03/07/2019	SETFIA, SSIA, SPF 27	SETFIA email: I will try to be really clear on this. There are not low levels of fishing in western Victoria. There will be up to 20 or perhaps even 30 vessels impacted in some way. Your footprint is small which meant that the fishing in your footprint is low and hard to get data on. You have decided to not obtain data due to the confidentiality issues which means we will never know who is actually fishing in that area. We will contact our members which are just two of several fishing sectors that will likely be working there. The wellheads will likely impact fishing operations because some methods (especially trawling) occur along a contour and your wellheads will be in the way. Do you have any data to show very few or even no vessels work that area?	Information provided by VFA and AFMA have indicated low levels of fishing in the seabed assessment areas as detailed in Appendix 4.8 Commonwealth managed fisheries and Appendix B4.9 Victorian management fisheries. Further information in relation to the data obtained on fishing levels were provided to SETFIA see Stakeholder Record SETFIA, SSIA, SPF 28. Further information relating to claim that trawl fishers may be impacted by subsea infrastructure see Stakeholder Record SETFIA, SSIA, SPF 81. Executive Summary (relevant points): 2.Trawl fishing in the SESSF CTS board trawl sub-sector does not occur in the Otway Offshore Project's (OOP) proposed footprint. It does occur to the SE of OOP. The grounds around the OOP footprint appear too rough for trawl fishing in its current form. 3.For unknown reasons gillnet fishing in the SESSF GHaT gillnet sub-sector does not seem to occur within the proposed OOP footprint. However, there is some activity from this sub-sector nearby to the east of the OOP. 5.There is no SESSF CTS Danish seine sub-sector fishing in the proposed OOP footprint. 6.Such a clear separation of commercial fishing, albeit only a few sectors, and oil/gas is highly unusual in SETFIA's considerable experience with reports such as this.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	04/07/2019	SETFIA, SSIA, SPF 28	Beach email: I should have said there are low levels of fishing in the area where our Project will be operating, rather than the western Victorian region generally. We do understand that western Victoria is an important area for many fishers. Apologies for not being more specific in my email. We have based our assessment of low levels of fishing in our project area on the following: • The data we have obtained from the Victorian Fishing Authority for the period of 2014 – 2018 showed low levels (<5 vessels) of fishing by the crab and rock lobster fishery in the area where we will be operating. • We also requested data from AFMA whose response was that there are currently no vessels active in the area we provided, which covered the area we will be operating in. We are following up with AFMA to clarify what timeframe they were referring to in this statement to ensure we understand their response fully. We are keen to know more about the potential impacts to fishing methods, both during the project and after any wellheads have been installed. Let me know if you need any further information to help you assess these impacts. Notwithstanding our current assessment of fishing effort, for the avoidance of doubt, we are happy to engage your notification services.	Provision of information in relation to fishing data obtained from VFA and AFMA for the broader Otway Development area. If any new or different information is provided by SETFIA this will be reviewed as per Section 8.23.2 Environment Plan review. If any objections or claims are raised from ongoing consultation with SETFIA these will be managed as detailed in Section 9.7.2 Management of objections or claims.
SETFIA, SSIA, SPF Stakeholder groups represented by	09/07/2019	SETFIA, SSIA, SPF 29	Beach email: Our EP for the Artisan Exploration well is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, don't hesitate to contact me if you have any questions.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Atlantis Fisheries Group			https://consultation.nopsema.gov.au/environment-division/4895/	
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	18/07/2019 – 19/07/2019 02/08/2019 – 06/08/2019	SETFIA, SSIA, SPF 30 - SETFIA, SSIA, SPF 36	Emails between Beach and SETFIA confirming commencement of SETFIA notification services for the Otway seabed survey and Purchase Order details.	Provision of information.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	03/09/2019 - 11/09/2019	SETFIA, SSIA, SPF 37 - SETFIA, SSIA, SPF 47	Emails between Beach and SETFIA (various unrelated to the drilling activity). SETFIA provided a review of the Beach Otway Offshore Project Proposed Seabed Assessment Locations 2 July 2019 Information Sheet and other documents associated with the seabed drilling locations assessment activity. Feedback was provided on the map and general information within the information sheets. SETFIA provided feedback from fishers they had spoken to that potentially fish within the broader Otway Offshore Project area. Two fishers detailed that they fish in the area and would like further information from Beach including information on compensation if they must avoid the area.	Provision of information. Beach engaged SETFIA to review fishing activity within Beach Otway Offshore Project area. The review identified that there was no trawl fishing or gill net fishing effort within or near to Beach existing or proposed offshore infrastructure (including Artisan-1 well location). This information has been used to inform the impact and risk evaluation in relation to interaction with Fishers. See stakeholder record below for further information on relation to the SETFIA review. Beach is maintaining ongoing consultation with SETFIA and its members in relation to activities that may affect fishers and has provided those fishers Beach's Commercial Fishing Operating Protocol (Appendix D) which includes information on compensation.
SETFIA, SSIA, SPF Stakeholder groups represented by Atlantis Fisheries Group	12/09/2019 - 29/10/2019	SETFIA, SSIA, SPF 48 SETFIA, SSIA, SPF 49 SETFIA, SSIA, SPF 51 – SETFIA, SSIA, SPF 68 SETFIA, SSIA, SPF 81	Emails between Beach and SETFIA to follow up on July 2019 correspondence covering contours for trawling, potential snagging / breaking strength for the fishing net used by local (trawl) fishers, confidentiality agreement and Beach Energy formal engagement of SETFIA to provide confidential information about commercial fishing in the trawl method sub-sector in the Commonwealth Trawl Sector (CTS) and the gillnet sub-sector in the Gillnet Hook and Trap Sector (GHaT). Both sectors are part of the larger Commonwealth Government managed Southern and Eastern Scalefish and Shark Fishery (SESSF). REPORT TO BEACH ENERGY ON TRAWL AND GILLNET FISHING ACTIVITY AROUND BEACH ENERGY'S PROPOSED OTWAY OFFSHORE PROJECT. 29 OCTOBER 2019. Executive Summary (relevant points for the Artisan-1 well): 2.Trawl fishing in the SESSF CTS board trawl sub-sector does not occur in the Otway Offshore Project's (OOP) proposed footprint. It does occur to the SE of OOP. The grounds around the OOP footprint appear too rough for trawl fishing in its current form. 3.For unknown reasons gillnet fishing in the SESSF GHaT gillnet sub-sector does not seem to occur within the proposed OOP footprint. However, there is some activity from this sub-sector nearby to the east of the OOP. 5.There is no SESSF CTS Danish seine sub-sector fishing in the proposed OOP footprint. 6.Such a clear separation of commercial fishing, albeit only a few sectors, and oil/gas is highly unusual in SETFIA's considerable experience with reports such as this.	Provision of information. Request for information – contours for trawling map / data. SETFIA Report to Beach indicates no trawl fishing effort within or near to Beach existing or proposed offshore infrastructure (including Artisan-1 well location) – this information has been used to inform the impact and risk evaluation in relation to interaction with Fishers.
SETFIA	21/04/2020	SETFIA 92	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
SETFIA	08/05/2020	SETFIA 93	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months.	Provision of information delay to drilling update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	
SETFIA	10/07/2020	SETFIA 102 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Sustainable Shark Fishing Inc (SSFI)	09/04/2019	SSFI 01 SSFI 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Sustainable Shark Fishing Inc (SSFI)	07/06/2019	SSFI 03 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	
Sustainable Shark Fishing Inc (SSFI)	02/07/2019	SSFI 04 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Sustainable Shark Fishing Inc (SSFI)	10/07/2019	SSFI 05	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Sustainable Shark Fishing Inc (SSFI)	21/04/2020	SSFI 16	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Sustainable Shark Fishing Inc (SSFI)	08/05/2020	SSFI 17	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed.	Provision of information delay to drilling update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	
Sustainable Shark Fishing Inc (SSFI)	10/07/2020	SSFI 22 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Tasmanian Abalone Council Limited	09/04/2019	TACL 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1& Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Tasmanian Abalone Council Limited	07/06/2019	TACL 02 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	
Tasmanian Abalone Council Limited	02/07/2019	TACL 03 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Tasmanian Abalone Council Limited	10/07/2019	TACL 04	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Tasmanian Abalone Council Limited	21/04/2020	TACL 14	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Tasmanian Abalone Council Limited	08/05/2020	TACL 15	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Tasmanian Abalone Council Limited	10/07/2020	TACL 20 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment	26/04/2019	TD 03 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. In January 2018, Beach Energy acquired Origin Energy's gas exploration and production assets in Victoria, Western Australia and New Zealand. With its head office in Adelaide, Beach Energy has been operating in Australia for over 50 years and has extensive experience in the gas industry. We would like to inform you that we're planning further development of our Otway offshore natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The 'Otway Offshore Project' will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The project is expected to start around September 2019, depending on regulatory approvals, weather windows and availability of contractors. I've attached a brief information sheet and further details are available by visiting our Otway Basin Victoria web page at https://www.beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us.	Provision of information.
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment / EPA Tasmania	21/05/2019	TD 04 – TD 09	Beach email providing copy of updated Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) Rev D for Tas State review. Beach requested response by 11th June 2019. Series of communications prior to formal feedback on draft OPEP on 05/06/2019.	Provision of information.
Tasmania Parks and Wildlife Service for	05/06/2019	TD 11 – TD 12	Beach email providing follow up to confirm key points discussed via telephone regarding Tas Sate review of Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) Rev D.	Confirmation of emergency spill response arrangements as discussed verbally.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Tasmanian Department of Primary Industries, Parks, Water and Environment / EPA Tasmania			Email response from DPIPWE Marine Pollution Officer confirming key points correct as per telephone conversation and further providing contact details and reporting protocols: The whale hotline is 0427942537 However our protocol is that the EPA 24 hour number is called to notify of the spill, then our officer does an assessment and contacts our wildlife people directly. Our EPA Pollution hotline number is 1800 005171.	All comments received from Tasmanian State government have been incorporated into the subsequent revision of the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907) prior to submission to NOPSEMA for assessment
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment / EPA Tasmania	07/06/2019	TD 13 OPOG19IS#1 & OPOG19IS#2	Beach email providing further updates to the Otway Offshore Project. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. Unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us.	Provision of information.
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment	2/07/2019	TD 14 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment	26/09/2019	TD 16	Beach email: regarding worst case hydrocarbon discharge scenarios for proposed activities in the Otway Basin incorporating tables outlining environment potentially exposure to low in-water thresholds from both a hypothetical diesel release from Artisan-1 well location and condensate release from Artisan-1 well location. Beach provide offer to supply any additional information upon request. Beach sought feedback on the above information and any potential controls required regarding hydrocarbon spill monitoring and/or notification protocols.	Provision of information and clarification. No response received from Tasmania Parks and Wildlife Service to date.
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks,	21/04/2020	TDPIPWE 32	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Water and Environment			Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment	08/05/2020	TDPIPWE 33	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Tasmania Parks and Wildlife Service for Tasmanian Department of Primary Industries, Parks, Water and Environment	10/07/2020	TDPIPWE 30 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Tasmanian Rock Lobster Fisherman's Association	09/04/2019	TRLFA 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. Drilling is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Tasmanian Rock Lobster Fisherman's Association	07/06/2019	TRLFA 02 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	
Tasmanian Rock Lobster Fisherman's Association	02/07/2019	TRLFA 03 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Tasmanian Rock Lobster Fisherman's Association	10/07/2019	TRLFA 04	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Tasmanian Rock Lobster Fisherman's Association	21/04/2020	TRLFA 15	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Tasmanian Rock Lobster Fisherman's Association	08/05/2020	TRLFA 17	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months.	Provision of information delay to drilling update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	
Tasmanian Rock Lobster Fisherman's Association	10/07/2020	TRLFA 21 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Tasmanian Seafood Industry Council (TISC)	09/04/2019	TSIC 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. The project is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Tasmanian Seafood Industry Council (TISC)	07/06/2019	TSIC 02 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	
Tasmanian Seafood Industry Council (TISC)	02/07/2019	TSIC 03 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Tasmanian Seafood Industry Council (TISC)	10/07/2019	TSIC 04	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Tasmanian Seafood Industry Council (TISC)	21/04/2020	TSIC 15	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Tasmanian Seafood Industry Council (TISC)	08/05/2020	TSIC 17	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed.	Provision of information delay to drilling update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	
Tasmanian Seafood Industry Council (TISC)	10/07/2020	TSIC 21 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Tuna Australia (ETBF Industry Association)	17/04/2019	TA 01 TA 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. The project is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.
Tuna Australia (ETBF Industry Association)	07/06/2019	TA 03 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	
Tuna Australia (ETBF Industry Association)	02/07/2019	TA 04 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Tuna Australia (ETBF Industry Association)	10/07/2019	TA 05	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Victorian Fisheries Authority (VFA)	05/02/2019 – 11/02/2019	VFA 01 VFA 02 VFA 03 - 06	Beach email to set up a time to meet. VFA email of acknowledgement. Emails to set up meeting.	NA
Victorian Fisheries Authority (VFA)	25/02/2019	VFA 07	Beach email providing overview of upcoming activities in Victoria including drilling activities, details include: Offshore activities including: seabed assessments over a series of 4 x 4 km areas; drilling and construction of exploration and production wells; installation of seabed infrastructure for successful wells. The activities will require safe operating zones around each seabed assessment and the MODU. We will send an information sheet on this project in the next week or so. To enable us to prepare our different environment plans, including any impacts on commercial fishing activity and mitigation plans that may be required, we need to assess fishing effort in Commonwealth and State managed fisheries. As such we are seeking VFA's support to provide data on Victorian State managed fisheries as follows: Catch data in each of the requested blocks/per block: • By month of year, for the last five years. • By species caught / tonnage of each. • By number of vessels operating. • If number of fishers < 5, return a "yes" in output field. • If no fishers, return a "no" in output field.	Request for information. It is noted that since this email was sent the areas of the seabed assessment have increased (See Section 4.2 operational area for details). The updates areas are within the fishing grids requested so updated information was not required from VFA.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Victorian Fisheries Authority (VFA)	04/03/2019	VFA 08	Beach follow-up email in relation to data request in VFA 07 and request to meet with VFA.	Follow-up of request for information.
Victorian Fisheries Authority (VFA)	06/03/2019	VFA 09 VFA 10 VFA 11	VFA email confirming data request had been sent and emails between Beach and VFA to arrange meeting on 12/03/19.	Follow-up of request for information.
Victorian Fisheries Authority (VFA)	12/03/2019	VFA 12	Meeting. Beach explained proposed offshore activities, discussed information sheet and map. Thanked VFA for providing fishing data and discussed low level of State managed (VFA) fishing activity in the vicinity. General discussion on Total Allowable Commercial Catch (TACC) and new harvest strategy. Beach asked if VFA could advise of any new strategies or research that may be relevant to assessment of any impacts from our operations. Also, that their website does not always show the latest TACC levels or strategies. VFA advised that they won't have much involvement in engagement regarding Beach's activities and mentioned industry representatives. Beach explained ongoing relationship with SIV, and Victorian Rock Lobster Association (VRLA), and that meeting SIV today.	VFA highlighted consultation with industry representatives. Beach is undertaking consultation with industry representatives including SIV, SETFIA and Victorian Rock Lobster Association.
Victorian Fisheries Authority (VFA)	18/04/2019	VFA 13 VFA 14 VFA 15 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email: Provision of information on the 'Otway Offshore Project and upcoming activities including drilling activities. In January 2018, Beach Energy acquired Origin Energy's gas exploration and production assets in Victoria, Western Australia and New Zealand. With its head office in Adelaide, Beach Energy has been operating in Australia for over 50 years and has extensive experience in the gas industry. We would like to inform you that we're planning further development of our Otway offshore natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The 'Otway Offshore Project' will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The project is expected to start around September 2019, depending on regulatory approvals, weather windows and availability of contractors. I've attached a brief information sheet and further details are available by visiting our Otway Basin Victoria web page at https://www.beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	Provision of information.
Victorian Fisheries Authority (VFA)	29/04/2019	VFA 16	Email from VFA: There is significant overlap with Victoria's rock lobster and giant crab fisheries. There has been approximately 18t of Giant crab and 40t of Southern Rock lobster taken from within the boundaries of the survey grid provided over past 10 years. Can you please also confirm "coordinates of all locations will be made available to relevant stakeholders after completion of planning" to advise of further overlap with fishing activity. I would also like to be kept informed with the outcomes and recommendations from this section: In preparation of Environment Plans a noise assessment on marine fauna will be completed to identify any potential impacts and mitigation plans that may be required. This will include assessment of any Vertical Seismic Profiling (VSP) as this may be required to validate one exploration well. Please also provide the EP for comment when available.	Beach provided VFA with an extract of the current draft of the Seabed Assessment EP chapters related to noise modelling and the identification of fisheries. See Record VFA 25. No Vertical Seismic Profiling (VSP) to be undertaken at the Artisan-1 well location. This extract provided the information in EP Section Appendix B.4.8 Victorian managed fisheries which details: • Based on information from SIV approximately 40 t of southern rock lobster has been caught within the operational area of the last 10 years. This equates to between 1.5 – 1.7% of the total catch over the 10 year period. • Based on information from SIV approximately 18 t of giant crab has been caught within the operational area of the last 10 years. The total catch over the last 10 years has been 157.8 t so 18 t equates to This equates to 11% of the total catch being caught in the operational area. A meeting was held with VFA to further discuss Beach's Otway development activities. See Record VFA 25.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Victorian Fisheries Authority (VFA)	30/04/2019 01/05/2019	VFA 17 VFA 18 VFA 19 VFA 20	Emails between Beach and VFA to arrange meeting. Meeting set for 3/5/2019.	See Record VFA 25.
Victorian Fisheries Authority (VFA)	02/05/2019	VFA 21 VFA 22 VFA 23 VFA 24	Beach email: Prior to tomorrow's meeting, can you clarify what you wanted in relation to the noise assessment? Is it just for VSP? VFA email: I am interested in the assessment and mitigation recommendations that follow. What are the outcomes for rock lobster and giant crab? Does this consider the studies that have indicated effects on RL? Beach email: Is the noise assessment (assessment and mitigations) just for the VSP activities? VFA email: I am interested in the assessment for all activities and their impacts.	See Record VFA 25 for details of the information provided to VFA. No Vertical Seismic Profiling (VSP) to be undertaken at the Artisan-1 well location.
Victorian Fisheries Authority (VFA)	03/05/2019	VFA 25	Meeting between Beach, VFA and SIV. Beach provided VFA with an extract of the current draft of the Seabed Assessment EP chapters related to noise modelling and the identification of fisheries. Beach stepped VFA through the noise modelling at a high level and the conclusions that there was no unacceptable impact to marine fauna. VFA said it was good to have the report and that they would review it in more detail. Beach explained the consultation approach with fishers; engagement had been via SIV who undertook a mailout of a 2-page information sheet (which had also been provided to VFA) to their approx. 300 members. A cover letter had asked for fishers to identify if they felt they would be impacted by the activities. SIV had reported that 4 fishers had come forward and 2 others had contacted Beach directly. Beach will engage with these fishers and SIV as part of on-going consultation and specifically when details of the exact locations and timing of the seabed assessments and drilling were available. Beach would also provide regular information on the location of vessels and MODUs to those who wanted to receive that information. VFA was comfortable with this approach. VFA asked about any permanent restrictions on fishing grounds, such as permanent exclusion zones, as this would reduce the available area for fishing. Beach explained that there may be a requirement for some wells to have exclusion zones around the infrastructure that will be installed on the seabed. At this stage the requirements for which wells and any details of the exclusion zones were not yet known. SIV joined the meeting and Beach gave a recap on the consultation that had been undertaken with commercial fishers. SIV was also provided with a copy of the draft EP extract. SIV informed VFA that they were happy with the way that Beach had undertaken the consultation and their plans for on-going consultation. Beach discussed with SIV a time when they could catch up to discuss the impacts on the four fishers that had identified themselves but no date was chosen due to current availability. SIV and VFA reviewed the fishing effort maps in the draft Seabed Assessment EP extract and queried the fishing activity for the giant crab map, in the grids located close to shore. Beach informed that the data had been provided by VFA.	Beach provided VFA with an extract of the current draft of the Seabed Assessment EP chapters related to noise modelling and the identification of fisheries. Beach will continue ongoing engagement with SIV and any affected fishers as per Section 9.7.1 Fishery specific consultation approach to ensure impacts to fishers are ALARP and an acceptable level. Beach has engaged directly with the fishers that contacted them. See Records for CRLF and CSF. VFA had raised concerns about loss of fishing area from permanent exclusion zones. During drilling activities, a temporary 500 m rig safety zone will be established, coinciding with the activity timing and duration (approximately 35-55 days). Additionally, a 2 km cautionary zone will be relayed to fishers via the AHO NTM process. Upon completion of the drilling activity, the Artisan-1 well is to be plugged and abandoned, unless the well has been assessed as viable for future production. Should Artisan-1 well be assessed as viable for future production, the well will be suspended, and a permanent PSZ will be established around the well location. Updated rock lobster and giant crab fishery maps were sent to VFA and SIV. See Record SIV 22 and VFA 27.
Victorian Fisheries Authority (VFA)	09/05/2019	VFA 26	Beach email requesting further fisheries data for grid L13.	Request for information. Grid L13 is outside the area where the Geographe and Thylacine wells will be drilled.
Victorian Fisheries Authority (VFA)	10/05/2019	VFA 27	Beach email providing updated information as discussed at meeting on 3/5/2019 Record VFA 25. In the extract of the EP Beach provided VFA and SIV commented on the fishing effort maps. Beach have reviewed the maps we discussed and are including revised versions in the EP we are submitting shortly. The updated maps were provided which show only the areas where there has been catch effort for rock lobsters and giant crabs within the seabed survey operational area. We have also firmed up the sizes of the seabed assessment survey areas which vary slightly to what was communicated in the Otway Offshore Information Sheet we published. The revised areas were provided. Don't hesitate to let me know if you have any questions.	Updated rock lobster and giant crab fishery maps showing overlap of fishery effort with the operational area within the Otway Development area which includes the Geographe and Thylacine wells where provided to SIV and VFA. Meeting will be set up with SIV to discuss the fishing effort of the four fishers who have raised with SIV that they fish in the area. Beach will continue ongoing engagement with SIV and any affected fishers as per Section 9.3.1 Fishery specific consultation approach to ensure impacts to fishers are ALARP and an acceptable level.
Victorian Fisheries Authority (VFA)		VFA 28 – VFA 40	Various emails requesting catch data information. Beach email requesting meeting. Meeting scheduled for 03/06/2019 – record VFA 41	Request for information

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Victorian Fisheries Authority (VFA)	03/06/2019	VFA 41 OPOG19IS#1 OPOG19IS#2	Meeting between Beach and VFA held at VFA office, Melbourne. Beach presented 2 x short information sheets which show the locations of the seabed assessment with coordinates and expected durations and sequence on the back. Similar sheet has been produced for drilling phase. The information sheets will help fishers plan around our activities. Beach offered to keep Fishers informed by text message of the location of the vessel on a regular basis to minimise impacts on each other. Beach offered compensation for damaged lines or rock lobster pots (attributable to Beach activities). There will be a 500 m exclusion zone around the MODU overlaid with a 2km cautionary zone so fishers know where we are. Petroleum Safety Zones (Otway Offshore Project): A potential PSZ has a 500 m radius. There will be a few PSZs created around the Thylacine wells and Beach is mapping these to see what they look like as a group. They won't be applied for yet until after the production wells are drilled. Generally, the infrastructure is located on a sandy sea bottom but the 500m zone may overlap some reefy areas. We will know more once we have the information from the seabed assessments to see what areas are included in the zones. Beach will come back to VFA once we have more information. VFA thanked Beach for coming to meet with them.	Ongoing stakeholder engagement commitment within EP (Section 9.7) to regularly update Fishers by text. During drilling activities, a temporary 500 m rig safety zone will be established, coinciding with the activity timing and duration (approximately 35-55 days). Additionally, a 2 km cautionary zone will be relayed to fishers via the AHO NTM process. Upon completion of the drilling activity, the Artisan-1 well is to be plugged and abandoned, unless the well has been assessed as viable for future production. Should Artisan-1 well be assessed as viable for future production, the well will be suspended, and a permanent PSZ will be established around the well location.
Victorian Fisheries Authority (VFA)	07/06/2019	VFA 42 OPOG19IS#1 & OPOG19IS#2	Beach email providing update information: The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. Unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of information
Victorian Fisheries Authority (VFA)	20/06/2019 26/06/2019	VFA 43 - 44	Beach email requesting further fisheries data for grid L13.	Request for information. Grid L13 is outside the area where the Artisan-1 well is proposed.
Victorian Fisheries Authority (VFA)	2/07/2019	VFA 45 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Victorian Fisheries Authority (VFA)	9/07/2019	VFA 46 VFA 47 VFA 48	Beach email: Our EP for the Artisan Exploration well is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, don't hesitate to contact me if you have any questions. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Victorian Fisheries Authority (VFA)	21/04/2020	VFA 63	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	Provision of information update
Victorian Fisheries Authority (VFA)	08/05/2020	VFA 65	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Victorian Fisheries Authority (VFA)	10/07/2020	VFA 69 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Victorian Recreational Fishing Peak Body (VR Fish)	9/04/2019	VRFISH 01 VRFISH 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1	Beach email providing information on Beach's Otway Offshore Project including drilling activities. The project is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
		Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2		
Victorian Recreational Fishing Peak Body (VR Fish)	07/06/2019	VRFISH 03 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	Provision of information.
Victorian Recreational Fishing Peak Body (VR Fish)	02/07/2019	VRFISH 04 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Victorian Recreational Fishing Peak Body (VR Fish)	10/07/2019	VRFISH 05	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Victorian Recreational Fishing Peak Body (VR Fish)	21/04/2020	VR-FISH 13	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
Victorian Recreational Fishing Peak Body (VR Fish)	08/05/2020	VR-FISH 14	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Victorian Recreational Fishing Peak Body (VR Fish)	10/07/2020	VR-FISH 16 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020 but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates). Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Victorian Rock Lobster Association (VRLA)	29/03/2019	VRLA 01 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	VRLA was included in SIVs mail-out of 2pp fact sheet to approx. 300 SIV members.	Provision of information. See Record SIV 14.
Victorian Rock Lobster	21/04/2020	VRLA 02	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Association (VRLA)			The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/. Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
Victorian Rock Lobster Association (VRLA)	08/05/2020	VRLA 03	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Victorian Rock Lobster Association (VRLA)	10/07/2020	VRLA 04 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020, but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.
Victorian Scallop Fishermen's Association Inc	17/04/2019	VSFA 01 VSFA 02 OP19IS#1 - Otway Offshore Program 2019 2pp Info Sheet #1 Link to: OP19IS#2 - Otway Offshore Program 2019 10pp Info Sheet #2	Beach email providing information on Beach's Otway Offshore Project including drilling activities. The project is expected to start around December 2019. Attached is a brief information sheet and further details are available on the Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Project Information Sheet' link. As part of our consultation we are engaging with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact me.	Provision of information.

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Victorian Scallop Fishermen's Association Inc	07/06/2019	VSFA 03 OPOG19IS#1 & OPOG19IS#2	Beach email providing information: As previously mentioned, the Otway Offshore Project will see up to 9 wells drilled offshore, consisting of exploration and production wells. Further activities in the Otway Basin will be carried out to ensure continued production at the Otway Gas Plant, including seabed site assessments, pre-drill activities, drilling of offshore gas wells, and subsea infrastructure installation. The first phase of the Seabed Site Assessments for the Otway Offshore Project will commence in September 2019. Please find attached an information sheet with the proposed seabed assessment locations and coordinates. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. The drilling component of the Otway Offshore Project will commence between December 2019 and February 2020. Please find attached an information sheet with the proposed drilling locations and coordinates, including an update exclusion zones for vessels. The order in which each location will be accessed will be confirmed as the activities progress. All dates are subject to fair sea state conditions. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list. Further details on the Otway Offshore Project are available by visiting our Otway Basin Victoria web page at beachenergy.com.au/vic-otway-basin/ and clicking on the 'Otway Offshore Information Sheet' link. We are consulting with commercial fishing associations on arrangements to ensure each other's operational plans are understood, helping to minimise any impacts to fishing activities and to Beach's offshore development program. In preparation of our Environment Plan we are keen to understand if you have any questions, concerns or feedback or require any further consultation. Please don't hesitate to contact us	Provision of information.
Victorian Scallop Fishermen's Association Inc	02/07/2019	VSFA 04 OP19-USAIS-P2/7 OPOG19IS#2	Beach email: Providing updated information on the seabed assessment areas and timings. Also provided an overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations. Please note, there have been no changes to the Drilling Information Sheet, which we have also re-attached for your convenience. We have also developed a Commercial Fisher Protocol which is outlined in the attached letter that we have drafted for you to use when sending the updated seabed assessment information to fishers. Let me know if you have any questions or concerns on this. Note that there is no change to the drilling locations we sent to you a few weeks ago. I've re-attached that information sheet for your convenience. As mentioned previously, unless otherwise requested, we will be in touch with confirmed locations, start dates and durations of Seabed Site Assessments and Drilling activities closer to the time. If you would like to be kept in touch via text message of confirmed locations, start dates and durations just prior to and during the activities, please let us know and we will add you to our distribution list. We will need you to provide your mobile phone number so we can include it on our list.	Provision of overview of Beach's Commercial Fisher Operating Protocol for seabed assessments and drilling operations.
Victorian Scallop Fishermen's Association Inc	10/07/2019	VSFA 05	Beach email: Beach's Environment Plan for the Artisan Exploration well, which is part of the Otway Offshore Project is available for public consultation on the NOPSEMA website. You can view it at the link below, which also has provision for comments to be made. As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenergy.com.au. https://consultation.nopsema.gov.au/environment-division/4895/	Provision of information.
Victorian Scallop Fishermen's Association Inc	21/04/2020	VSFA 16	Beach write to advise that the commencement of Beach's Otway Offshore drilling campaign– which will be completed in Commonwealth waters - will be delayed and is unlikely to start before July 2020. The Ocean Onyx rig arrived in Victorian state waters last week. As the arrival date was later than had been agreed and specified in the rig contract, Beach exercised its right to terminate the agreement. All parties are engaging in discussions with a view to agreeing a new contract in due course. Further information on this announcement, can be found https://www.beachenergy.com.au/asx/.	Provision of information update

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
			Once a new date is confirmed, Beach will provide at least four weeks' notice before drilling commences.	
Victorian Scallop Fishermen's Association Inc	08/05/2020	VSFA 18	Further to Beach's last update regarding Beach's Otway Offshore drilling campaign, Beach write to inform you that drilling will commence at a date to be determined, which will be after 1st July, 2020 and will be completed before the 30th December, 2023. The drilling will take between 18 and 24 months. Once the start of drilling has been confirmed, stakeholders will be advised with a minimum of 4 weeks' notice before the drilling campaign commences and a drilling schedule including the wells sequence and drilling duration of each well will be provided to potentially impacted stakeholders and any changes will be communicated in advance once drilling is confirmed. You can find out more about Beach's offshore Otway drilling campaign at https://www.beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact us on 1800 797 011 or reply to this email at community@beachenery.com.au	Provision of information delay to drilling update
Victorian Scallop Fishermen's Association Inc	10/07/2020	VSFA 21 Beach Artisan-1 Well Location.jpg	Beach write to provide you with an update regarding Beach's Otway Offshore drilling campaign. The Artisan Drilling Environmental Plan (EP) was accepted by the National Offshore Petroleum and Safety Management Authority (NOPSEMA) on the 3 March 2020. The delay in the drilling campaign due to rig contracting has triggered a resubmission of the EP to NOPSEMA for acceptance, with the below changes: • The proposed drilling period for the Artisan-1 well (location map attached) remains unchanged at approximately 35 to 55 days. However, the drilling campaign is now due to commence sometime after October 2020 but may be up to end of 2021. Once a rig has been contracted Beach will provide more detail on the start date. • The drill rig anchors are already in place and will remain until drilling has been completed. The following has been issued by AMSA: SECURITE FM JRCC AUSTRALIA 230928Z JUN 20 AUSCOAST WARNING 223/20 EIGHT YELLOW SURFACE BUOYS THREE METRES IN HEIGHT WHITE FLASHING 3 SECONDS DEPLOYED WITHIN ONE MILE OF POSITION 20-34.6S 114-46.6E. TWO MILE CLEARANCE REQUESTED. • A Petroleum Safety Zone (PSZ) is in place and extends to a distance of 500m from the Artisan-1 well (latitude 38:53:29.466 South, longitude 142:52:56.921 East: GDA94 coordinates) Upon resubmission of the EP, NOPSEMA will upload it to their website for public comment via the following link info.nopsema.gov.au/home/open_for_comment. The public comment period will remain open for 30 days. You can find out more about Beach's offshore Otway drilling campaign at beachenergy.com.au/vic-otway-basin/ As always, if you have any questions, please don't hesitate to contact Beach on 1800 797 011 or reply to this email at community@beachenergy.com.au	Provision of information update on resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ are now in place.

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Appendix A EPBC Act Protected Matters Search Reports

A.1: Spill EMBA

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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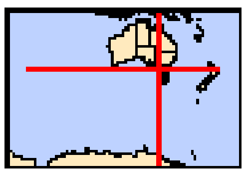
Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	3
Wetlands of International Importance:	6
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	104
Listed Migratory Species:	76

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	7
Commonwealth Heritage Places:	8
Listed Marine Species:	129
Whales and Other Cetaceans:	30
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	5

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	68
Regional Forest Agreements:	3
Invasive Species:	56
Nationally Important Wetlands:	10
Key Ecological Features (Marine)	3

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place
Point Nepean Defence Sites and Quarantine Station Area	VIC	Listed place
Quarantine Station and Surrounds	VIC	Within listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Corner inlet	Within 10km of Ramsar
Glenelg estuary and discovery bay wetlands	Within Ramsar site
Lavinia	Within Ramsar site
Piccaninnie ponds karst wetlands	Within 10km of Ramsar
Port phillip bay (western shoreline) and bellarine peninsula	Within Ramsar site
Western port	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-east

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community may occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Acanthiza pusilla archibaldi King Island Brown Thornbill, Brown Thornbill (King Island) [59430]	Endangered	Species or species habitat likely to occur within area
Acanthornis magna greeniana King Island Scrubtit, Scrubtit (King Island) [82329]	Critically Endangered	Species or species habitat known to occur within area
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Aquila audax fleayi Tasmanian Wedge-tailed Eagle, Wedge-tailed Eagle (Tasmanian) [64435]	Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Ceyx azureus diemenensis Tasmanian Azure Kingfisher [25977]	Endangered	Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Platycercus caledonicus brownii Green Rosella (King Island) [67041]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Strepera fuliginosa colei Black Currawong (King Island) [67113]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Crustaceans		
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat may occur within area
Fish		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat known to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat likely to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Frogs		
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Roosting known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat known to occur within area
Caladenia calcicola Limestone Spider-orchid [10065]	Vulnerable	Species or species habitat likely to occur within area
Caladenia colorata Coloured Spider-orchid, Small Western Spider-orchid, Painted Spider-orchid [54999]	Endangered	Species or species habitat likely to occur within area
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area
Caladenia insularis French Island Spider-orchid [24372]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Caladenia orientalis Eastern Spider Orchid [83410]	Endangered	Species or species habitat known to occur within area
Caladenia robinsonii Frankston Spider-orchid [24375]	Endangered	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat known to occur within area
Euphrasia collina subsp. muelleri Purple Eyebright, Mueller's Eyebright [16151]	Endangered	Species or species habitat known to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Grevillea infecunda Anglesea Grevillea [22026]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Hypolepis distans Scrambling Ground-fern [2148]	Endangered	Species or species habitat likely to occur within area
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area
Leiocarpa gatesii Wrinkled Buttons [76212]	Vulnerable	Species or species habitat likely to occur within area
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat may occur within area
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat likely to occur within area
Pomaderris halmaturina subsp. halmaturina Kangaroo Island Pomaderris [21964]	Vulnerable	Species or species habitat known to occur within area
Prasophyllum frenchii Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat likely to occur within area
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area
Pterostylis ziegeleri Grassland Greenhood, Cape Portland Greenhood [64971]	Vulnerable	Species or species habitat may occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat likely to occur within area
Taraxacum cygnorum Coast Dandelion [2508]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat likely to occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - CROWS NEST CAMP - QUEENSCLIFF
Defence - HMAS CERBERUS
Defence - STAFF COLLEGE-FORT QUEENSCLIFF
Defence - SWAN ISLAND TRAINING AREA
Defence - TRAINING CENTRE (Norris Barracks) - Portsea
Defence - WEST HEAD GUNNERY RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
HMAS Cerberus Marine and Coastal Area	VIC	Listed place
Swan Island and Naval Waters	VIC	Listed place
Historic		
Cape Wickham Lighthouse	TAS	Listed place
Fort Queenscliff	VIC	Listed place
HMAS Cerberus Central Area Group	VIC	Listed place
Sorrento Post Office	VIC	Listed place
Swan Island Defence Precinct	VIC	Listed place
Wilsons Promontory Lighthouse	VIC	Listed place

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Larus dominicanus Kelp Gull [809]		Breeding known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Morus capensis Cape Gannet [59569]		Breeding known to occur within area
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat known to occur within area
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche sp. nov.		
Pacific Albatross [66511]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis		
Hooded Plover [59510]		Species or species habitat known to occur within area
Thinornis rubricollis rubricollis		
Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat known to occur within area
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe		
Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys tryoni		
Tryon's Pipefish [66193]		Species or species habitat may occur within area
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis		
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps		
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus minotaur		
Bullneck Seahorse [66705]		Species or species habitat may occur within area
Histiogamphelus briggsii		
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus		
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus		
Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus		
Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Kimblaeus bassensis		
Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
[Leptoichthys fistularius] Brushtail Pipefish [66248]		Species or species habitat may occur within area
[Lissocampus caudalis] Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
[Lissocampus runa] Javelin Pipefish [66251]		Species or species habitat may occur within area
[Maroubra perserrata] Sawtooth Pipefish [66252]		Species or species habitat may occur within area
[Mitotichthys mollisoni] Mollison's Pipefish [66260]		Species or species habitat may occur within area
[Mitotichthys semistriatus] Halfbanded Pipefish [66261]		Species or species habitat may occur within area
[Mitotichthys tuckeri] Tucker's Pipefish [66262]		Species or species habitat may occur within area
[Notiocampus ruber] Red Pipefish [66265]		Species or species habitat may occur within area
[Phycodurus eques] Leafy Seadragon [66267]		Species or species habitat may occur within area
[Phyllopteryx taeniolatus] Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
[Pugnaso curtirostris] Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
[Solegnathus robustus] Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
[Solegnathus spinosissimus] Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
[Stigmatopora argus] Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
[Stigmatopora nigra] Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
[Stipecampus cristatus] Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
[Syngnathoides biaculeatus] Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
[Urocampus carinirostris] Hairy Pipefish [66282]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area

Name	Status	Type of Presence
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Apollo	Multiple Use Zone (IUCN VI)
Beagle	Multiple Use Zone (IUCN VI)
Murray	Multiple Use Zone (IUCN VI)
Nelson	Special Purpose Zone (IUCN VI)
Zeehan	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Aire River	VIC
Aireys Inlet B.R.	VIC
Anglesea B.R.	VIC
Anglesea Heath	VIC
Anser Island	VIC
Bay of Islands Coastal Park	VIC
Bucks Lake	SA
Canunda	SA
Cape Liptrap Coastal Park	VIC
Cape Nelson	VIC
Cape Patterson N.C.R	VIC
Cape Wickham	TAS
Cape Wickham	TAS
Carpenter Rocks	SA
Cone Islet	TAS
Crib Point G228 B.R.	VIC
Crib Point G229 B.R.	VIC
Curtis Island	TAS
Devils Tower	TAS
Disappointment Bay	TAS
Discovery Bay Coastal Park	VIC
Douglas Point	SA
East Moncoeur Island	TAS
Edna Bowman N.C.R.	VIC
Fingal B.R	VIC
Flinders G234 B.R.	VIC
Flinders N.F.R.	VIC
French Island G230 B.R	VIC
French Island National Park	VIC
Great Otway National Park	VIC
Hogan Group	TAS
Kilcunda N.C.R.	VIC
Lady Julia Percy Island W.R.	VIC
Lake Connewarre W.R	VIC
Lake Flannigan	TAS
Latrobe B.R.	VIC
Lavinia	TAS

Name	State
Lawrence Rocks W.R.	VIC
Lily Pond B.R.	VIC
Lonsdale Lakes W.R	VIC
Marengo N.C.R.	VIC
Merricks Creek B.R.	VIC
Mornington Peninsula National Park	VIC
Mount Vereker Creek	VIC
Nene Valley	SA
North East Islet	TAS
Parker River	VIC
Phillip Island Nature Park	VIC
Point Nepean National Park	VIC
Port Campbell National Park	VIC
Princetown W.R	VIC
Queenscliff N.F.R	VIC
Reef Island and Bass River Mouth N.C.R	VIC
Rodondo Island	TAS
Rosebud B.R.	VIC
Seal Islands W.R.	VIC
Southern Wilsons Promontory	VIC
Stony Creek (Otways)	VIC
Swan Bay - Edwards Point W.R	VIC
Unnamed (No.HA26)	SA
Ventnor B.R.	VIC
Vereker Creek	VIC
Warrengine Creek SS.R.	VIC
West Moncoeur Island	TAS
Wilsons Promontory	VIC
Wilsons Promontory Islands	VIC
Wilsons Promontory National Park	VIC
Wonthaggi Heathlands N.C.R	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
Gippsland RFA	Victoria
Tasmania RFA	Tasmania
West Victoria RFA	Victoria

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Callipepla californica California Quail [59451]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Gallus gallus Red Junglefowl, Domestic Fowl [917]		Species or species habitat likely to occur within area
Meleagris gallopavo Wild Turkey [64380]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pavo cristatus Indian Peafowl, Peacock [919]		Species or species habitat likely to occur within area
Phasianus colchicus Common Pheasant [920]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Turdus philomelos Song Thrush [597]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Austrocylindropuntia spp. Prickly Pears [85132]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Anderson Inlet	VIC
Lake Connewarre State Wildlife Reserve	VIC
Lake Flannigan	TAS
Lavinia Nature Reserve	TAS
Lower Aire River Wetlands	VIC
Mud Islands	VIC
Powlett River Mouth	VIC
Princetown Wetlands	VIC
Swan Bay & Swan Island	VIC

Name	State
Western Port	VIC

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Bonney Coast Upwelling	South-east
Upwelling East of Eden	South-east
West Tasmania Canyons	South-east

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.8428 143.5383,-38.7126 143.7366,-38.5023 144.002,-38.3574 144.2852,-38.1751 144.7888,-38.362 144.9108,-38.4825 144.9108,-38.293 145.2239,-38.4865 145.428,-38.6681 145.622,-38.674 145.827,-38.8843 145.9514,-39.1399 146.3834,-38.9745 146.2708,-38.9361 146.8688,-38.6257 147.4575,-38.0947 148.1286,-39.2583 147.1622,-39.5083 146.637,-39.3863 145.0864,-39.9321 144.3422,-39.6229 144.0166,-39.6679 143.0985,-40.1452 142.6635,-38.1752 139.2053,-36.7803 138.1301,-37.6875 140.1321,-37.9495 140.4363,-38.0705 140.6391,-38.0964 141.0461,-38.4018 141.5279,-38.395 142.1668,-38.4546 142.6148,-38.6539 143.0869,-38.8428 143.5383

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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A.2: Operational Area – 2 km

Australian Government

Department of the Environment and Energy

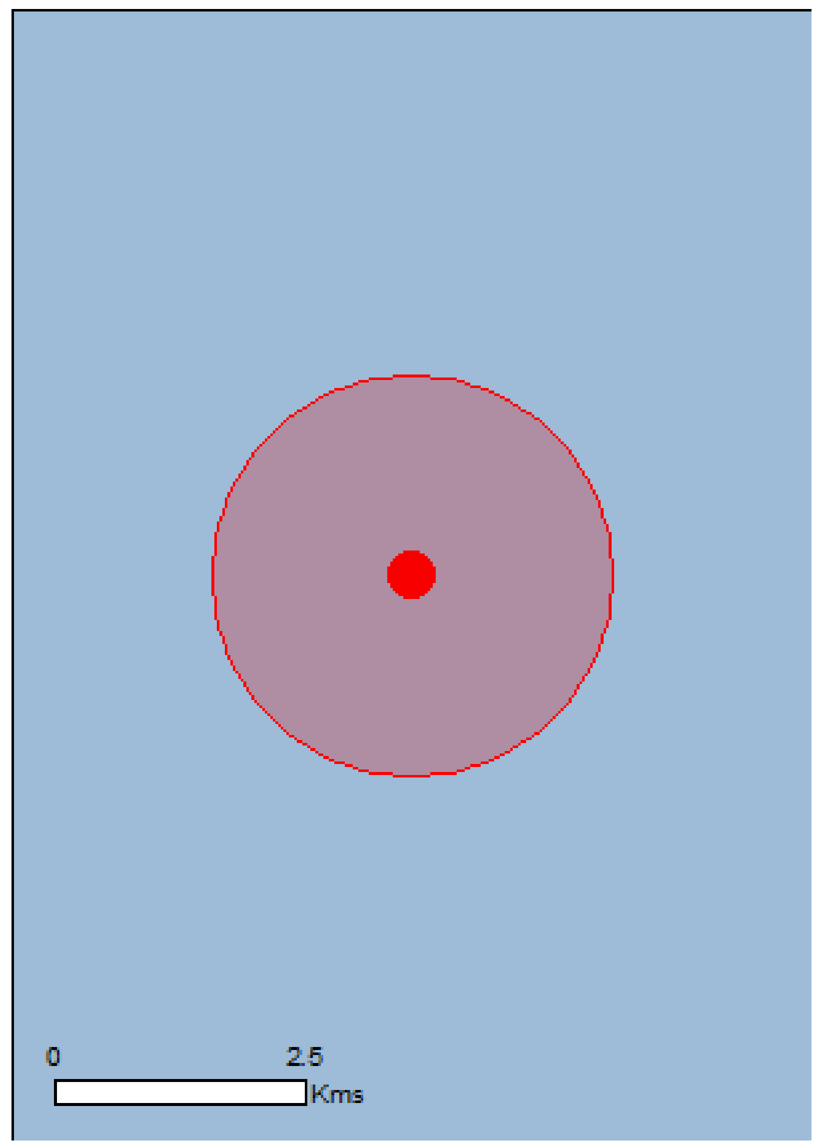
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

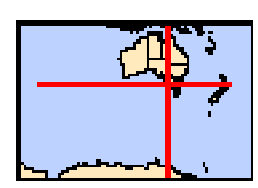
Report created: 07/12/19 14:12:54



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	32
Listed Migratory Species:	36

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	58
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-east

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Catharacta skua		
Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known

Name	Status	Type of Presence
		to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.88469 142.86928

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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A.3: Light and Noise Behaviour EMBA – 20 km

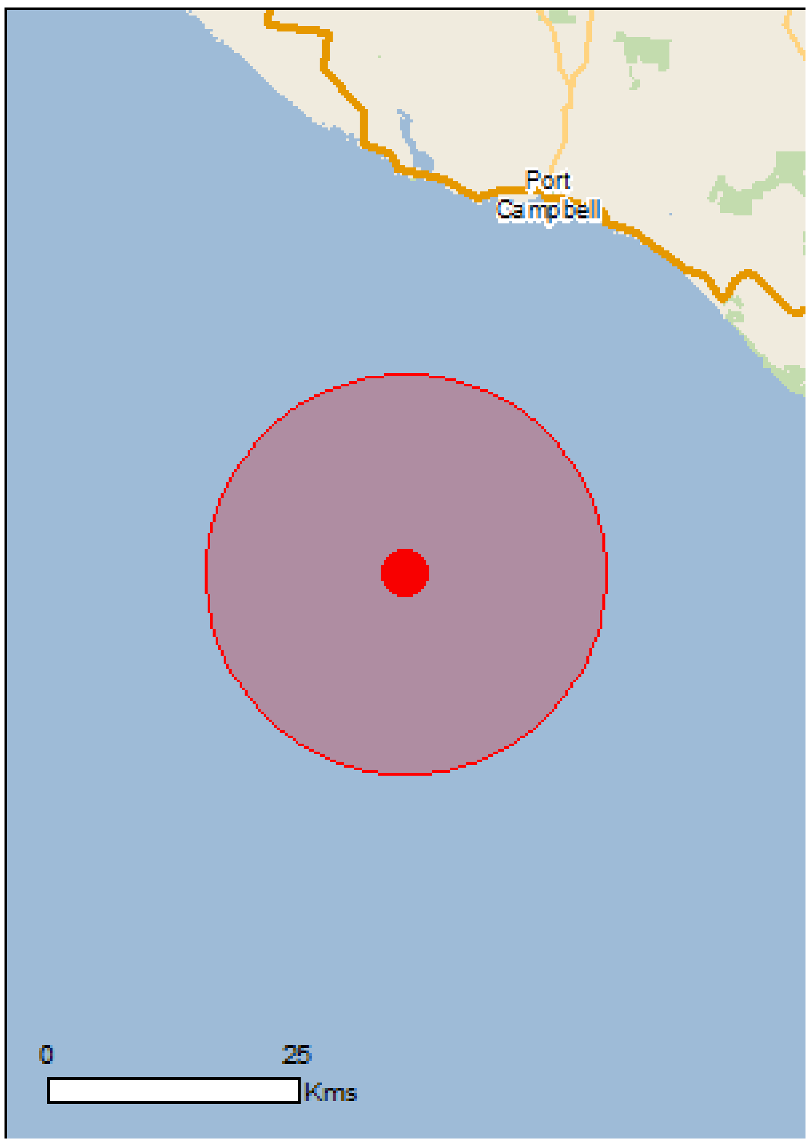
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

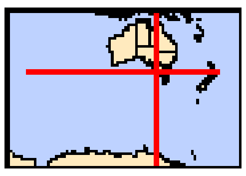
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/01/20 00:39:43



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	35
Listed Migratory Species:	38

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	62
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-east

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
[Neophema chrysogaster](#) Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pachyptila turtur subantarctica](#) Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
[Phoebetria fusca](#) Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
[Pterodroma leucoptera leucoptera](#) Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
[Pterodroma mollis](#) Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
[Sternula nereis nereis](#) Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche bulleri](#) Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche bulleri platei](#) Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche cauta cauta](#) Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche cauta steadi](#) White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche chrysostoma](#) Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
[Thalassarche impavida](#) Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche melanophris](#) Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thalassarche salvini](#) Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Thinornis rubricollis rubricollis](#) Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat may occur within area
Fish		
[Prototroctes maraena](#) Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Mammals		
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat may occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish		Species or species

Name	Threatened	Type of Presence
[66249]		habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted		Species or species

Name	Status	Type of Presence
Bottlenose Dolphin [68418]		habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.88469 142.86928

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

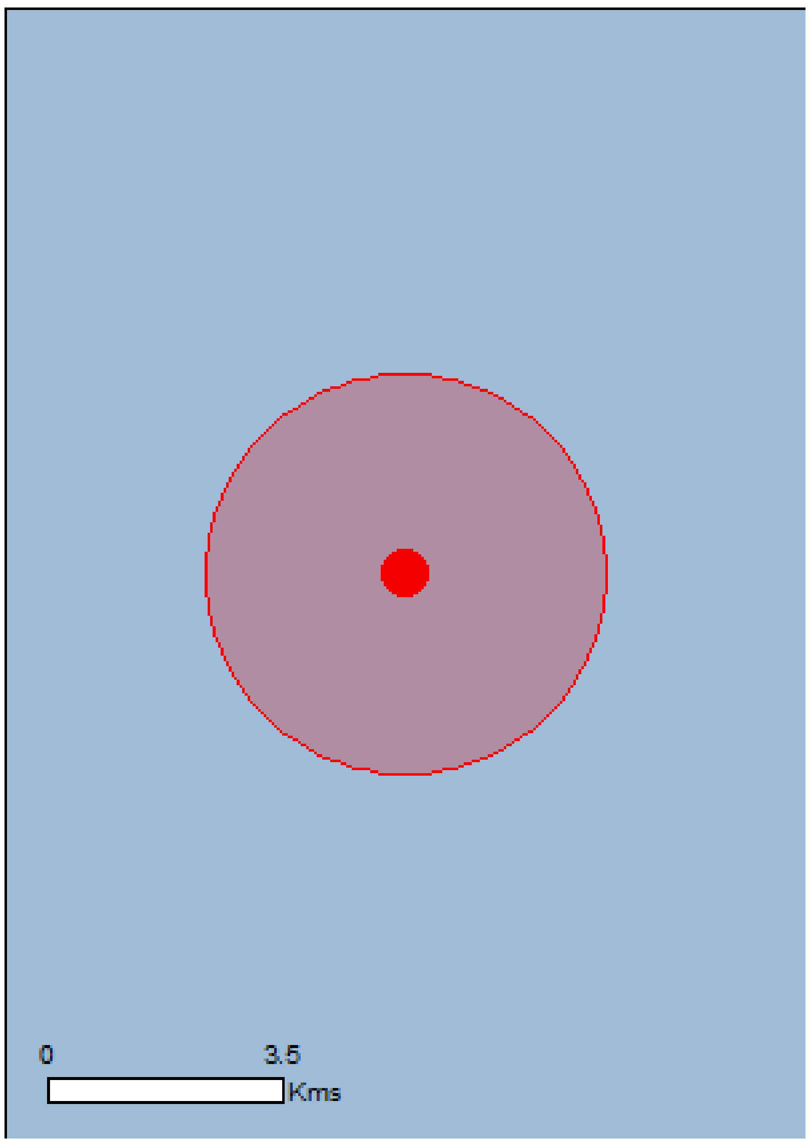
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

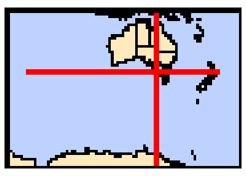
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 08/06/20 10:13:16



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 3.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	32
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	59
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-east

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.88469 142.86928

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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A.5: Waste Water EMBA– 2.5 km

Australian Government

Department of the Environment and Energy

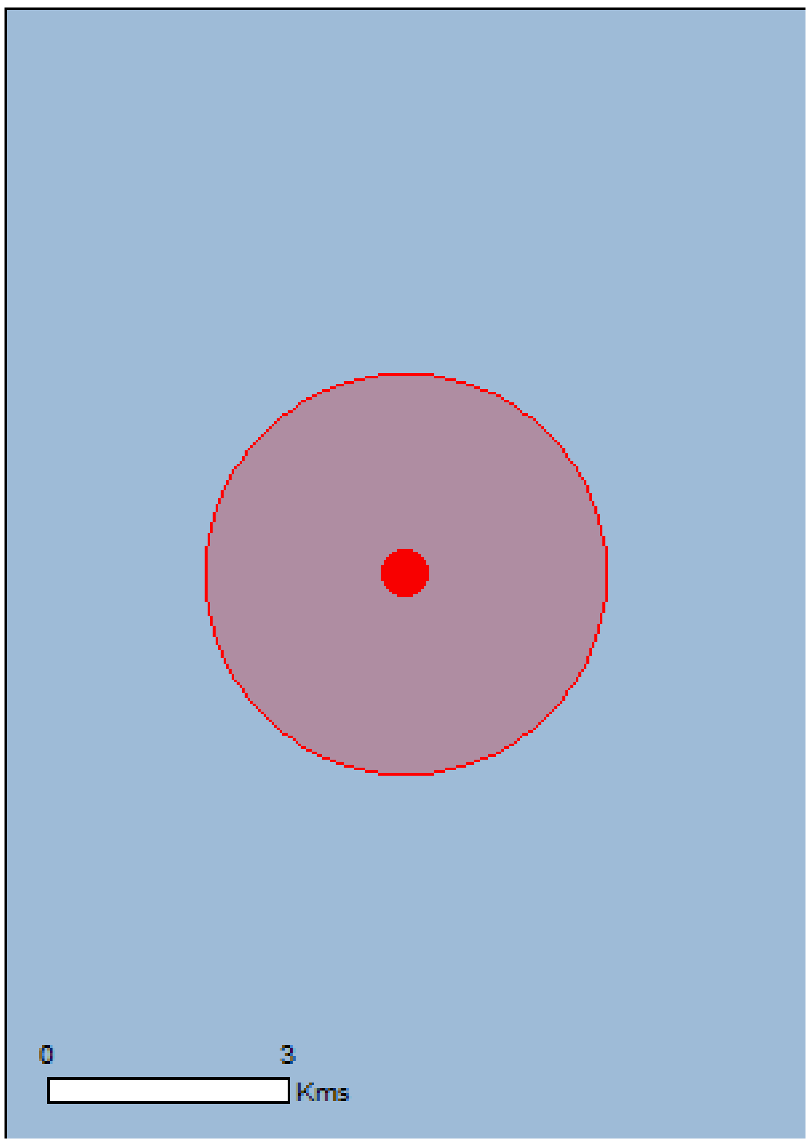
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

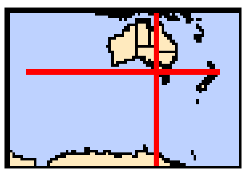
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/01/20 11:11:02



Coordinates

Buffer: 2.5Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	32
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	59
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-east

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche sp. nov. Pacific Albatross [66511]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-38.88469 142.86928

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B RPS APASA Artisan-1 Spill Model Report

Report

13 JUNE 2019

Beach Energy Artisan-1 Exploration Well

Oil Spill Modelling

RPS

Document status

Version	Purpose of document	Authored by	Reviewed by	Review date
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Approval for issue

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Terms and Abbreviations

°	Degrees
‘	Minutes
“	Seconds
Actionable oil	Oil which is thick enough for effective use of mitigation strategies, such as mechanical clean up (e.g. skimmers), booms, dispersed, or burned
AMP	Australian marine parks
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute gravity (A measure of how heavy or light a petroleum liquid in comparison to water)
ASTM	American Society for Testing and Materials
Bonn Agreement Oil Appearance Code	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union
°C	Degree Celsius (unit of temperature)
cP	Centipoise (unit of viscosity)
CFSR	Climate Forecast System Reanalysis
cm	Centimetre (unit of length)
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions
Dissolved hydrocarbons	Dissolved hydrocarbons within the water column with alternating double and single bonds between carbon atoms forming rings, containing at least one six-membered benzene ring
g/m^2	Grams per square meter (unit of surface or area density)
EIA	Environmental impact assessment
Entrained oil	Droplets or globules of oil that are physically mixed (but not dissolved) into the water column. Physical entrainment can occur either during pressurised release from a subsurface location, or through the action of breaking waves (>12 knots)
EP	Environmental plan
EEZ	Exclusive Economic Zone
Evaporation	The process whereby components of the oil mixture are transferred from the sea-surface to the atmosphere
GODAE	Global Ocean Data Assimilation Experiment
HYCOM	Hybrid Coordinate Ocean Model is a data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction
IOA	Index of Agreement gives a non-dimensional measure of model accuracy or performance
IBRA	Interim Biogeographic Regionalisation for Australia

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IMCRA	Integrated Marine and Coastal Regionalisation of Australia
Isopycnal layers	Water column layers with corresponding water densities
ITOPF	The International Tanker Owners Pollution Federation
KEF	Key Ecological Feature
km	Kilometre (unit of length)
km^2	Square Kilometres (unit of area)
KEF	Key ecological feature
Knot	unit of wind speed (1 knot = 0.514 m/s)
LGA	Local Government Area
LOWC	Loss of Well Control
m	Metres (unit of length)
m^2	Metres squared (unit of area)
m^3	Metres cubed (unit of volume)
m/s	Metres per Second (unit of speed)
MAE	Mean Absolute Error is the average of the absolute values of the difference between model predicted and observed data (e.g. surface elevations)
MB	Marine boundary
MNP	Marine National Park
RSB	Reefs, Shoals and Banks
MS	Marine Sanctuary
NASA	National Aeronautics and Space Administration
NCEP	National Centres for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
nm	nautical mile (unit of distance; 1 nm = 1.852 km)
NP	National Parks
Ocean current	Large scale and continuous movement of seawater generated by forces such as breaking waves, wind, the Coriolis effect, and temperature and salinity gradients. It is the main flow of ocean waters
OECD	Organisation for Economic Co-operation and Development
ppb	Parts per billion (concentration)
ppb.hrs	ppb multiplied for hours (concentration x time)
PSU	Practical salinity units
Ramsar site	A wetland site designated of international importance under the Ramsar Convention
Ramsar Convention	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Sea surface exposure	Floating oil on the sea surface equal to or above reporting threshold (e.g. 0.5 g/m^2)
Shoreline contact	Stranded oil on the shoreline equal to or above reporting threshold (e.g. 10 g/m^2)

SIMAP	Spill Impact Mapping Analysis Program
US EPA	United States Environmental Protection Agency
Visible oil	Floating oil on the sea surface equal to or above reporting threshold (e.g. 0.5 g/m^2)

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EXECUTIVE SUMMARY

Background

Beach Energy is intending to undertake further development of the Otway offshore natural gas reserves. The proposed development will include the drilling of offshore exploration wells situated in the Otway Basin, starting with the Artisan-1 gas well. In order to support the development of environmental approvals for the drilling program, a comprehensive oil spill modelling study was commissioned which considered the following two hypothetical spill scenarios:

- 300 m^3 surface release of marine diesel over 6 hours in the event of a containment loss from a vessel at the Artisan-1 well location; and
- 222,224 bbl subsea release of condensate over 86 days to represent an unrestricted open-hole loss of well control (LOWC) event from the Artisan-1.

SIMAP's (Spill Impact Mapping Analysis Program) stochastic model was used to quantify the probability of exposure from a spill to the sea (surface and in-water), and the probability of shoreline contact from hypothetical spill scenarios. The SIMAP system and the methods and analysis presented herein, use modelling algorithms which have been peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Methodology

The modelling study was carried out in several stages. Firstly, a five-year current dataset (2008–2012) that includes the combined influence of three-dimensional ocean and tidal currents was developed. Secondly, the currents, spatial winds and then detailed hydrocarbon properties were used as inputs in the oil spill model to simulate the drift, spread, weathering, entrainment and fate of the spilled hydrocarbons.

As spills can occur during any set of wind and current conditions, a total of 100 spill trajectories per hypothetical spill scenario per season (e.g. summer and winter) were initiated at random times within a 5-year period (2008–2012) to enable a robust statistical analysis.

Each simulation was configurated with the same spill information (i.e. spill volume, duration and oil type) except for the start time and date which in turns, ensures that the predicted transport and weathering of an oil slick is subject to a wide range of current and wind conditions.

Oil Properties

The marine diesel oil (MDO) used for Scenario 1, is a light-persistent fuel oil used in the maritime industry. It has a density of 829.1 kg/m^3 (API of 37.6), a low pour point (-14^{o}C) and low viscosity (4cP). According to the International Tankers Owners Pollution Federation (ITOPF, 2014) and AMSA (2015a) guidelines, this oil is categorised as a group II oil (light-persistent).

Thylacine condensate was used for the loss of well control scenario (Scenario 2). The condensate has an API of 44.3, density of 804.6 kg/m^3 at 15ºC) with low viscosity (0.875 cP), classifying it as a Group I oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and USEPA/USCG classifications. The condensate comprises a significant portion of volatiles and semi to low volatiles (99% total) with very little residual components (<1%).

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Key Findings

Scenario: 300 m^3 surface release of marine diesel oil

Sea surface exposure

- No shoreline contact above the minimum threshold (>10 g/m^2) was predicted for any of the seasons modelled.
- During summer conditions, low (0.5 g/m^2) and moderate (10 g/m^2) exposure to surface hydrocarbons were predicted to travel a maximum distance of 68 km and 12 km from the release location, respectively. During winter, low and moderate exposure of surface hydrocarbons extended to a maximum distance of 93 km and 10 km from the release location, respectively.
- The modelling results demonstrated a 1% probability of oil exposure on the sea surface for the Central Victoria Integrated Marine and Coastal Regionalisation of Australia (IMCRA) receptor, during the summer season.
- During winter conditions, there was a 1% probability of oil exposure on the sea surface for several receptors including the Central Victoria and Central Bass Strait IMCRA, Apollo Australian Marine Park (AMP) and within Victorian State Waters.
- None of the receptors were exposed at or above the moderate or high (>25 g/m^2) thresholds with the exception of the Otway IMCRA. This receptor registered low, moderate and high exposure to sea surface hydrocarbons due to the release location being situated within the boundaries of this receptor.

Dissolved hydrocarbon exposure

- There was no dissolved hydrocarbon exposure (over the 48-hour window) in the 0-10 m depth layer to receptors at or above the low threshold (6 ppb), with the exception of the Otway IMCRA which registered 8 ppb and 9 ppb during summer and winter conditions, respectively. None of the receptors recorded exposure (over 48 hours) at or above the moderate (50 ppb) or high (400 ppb) thresholds.
- At the depths of 0-10 m, the dissolved hydrocarbon exposure over 1 hour was predicted for the Otway IMCRA, with the maximum concentration of 76 ppb during summer and 59 ppb during winter. No moderate or high dissolved hydrocarbons exposure (over 1 hour) was predicted for any receptors, except for the Otway IMCRA.

Entrained hydrocarbon exposure

- At the depths of 0-10 m, the maximum entrained hydrocarbon exposure (over a 48-hour window) during summer and winter conditions was 2,182 ppb and 792 ppb, respectively. None of the receptors were exposed at or above the moderate (10-100 ppb) or high (>1,000 ppb) thresholds, excluding the Otway IMCRA.
- Within the 0-10 m depth layer, the maximum entrained hydrocarbon exposure (over 1 hour) for the Otway IMCRA was 5,933 ppb and 5,046 ppb, during summer and winter conditions, respectively. For receptors other than the Otway IMCRA (83% summer and 93% winter), 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 other receptors were exposed at or above the high threshold (>1,000 ppb), except for the Otway IMCRA.

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Scenario: 222,224 bbl subsea release of condensate over 86 days

Sea surface exposure

- During summer conditions, low (0.5 -10 g/m^2) and moderate (10 - 25 g/m^2) exposure to surface hydrocarbons were predicted to travel a maximum distance of 52 km and 4 km from the release location, respectively. Under winter conditions, low and moderate exposure from surface hydrocarbons extended to a maximum distance of 53 km and 3 km from the release location, respectively. Note, no high exposure was predicted on the sea surface for any of the seasons assessed.
- During summer conditions, the probability of hydrocarbon exposure on the sea surface at or above the low threshold was predicted to range from 6% (Otway Ranges Interim Biogeographic Regionalisation for Australia (IBRA) sub-region) to 16% (Colac Otway and Cape Otway West sub-LGAs and within Victorian State Waters). The exception is the Otway IMCRA (100% during both seasons). The winter modelling results demonstrated a larger number of receptors exposed to surface hydrocarbons at or above the low threshold. The probability ranged from 3% (Twelve Apostles MNP and Otway Ranges IBRA) to 40% (Otway Plain IBRA; Cape Otway West sub-LGA and Colac Otway LGA). No other receptors except the Otway IMCRA were exposed to moderate or high levels for any seasons assessed.

Shoreline contact

- The probability of contact to any shoreline was 16% and 57% for the summer and winter season, respectively. While the minimum time for visible surface hydrocarbons to reach a shoreline was 3 days for 5 days, respectively.
- The maximum volume of hydrocarbons predicted to come ashore was 15 m^3 and 33 m^3, during summer and winter conditions, respectively, while the maximum length of shoreline contacted above the low threshold (10 – 100 g/m^2) was 7.0 km and 11.0 km, respectively. Note, no shoreline loading was predicted for the high threshold (above 1,000 g/m^2).
- Cape Otway West LGA was the receptor predicted with the greatest probability of contact above the low and moderate thresholds during summer (16% and 15%, respectively) and winter (40% for both thresholds) conditions. The modelling results during winter conditions demonstrated additional shoreline contact to Moyne, Corangamite, Moonlight head and Childers Cove.

In-water exposure

- At the depth of 0-10 m, the maximum concentration of dissolved hydrocarbons over the 48-hour window was 30 ppb in summer and 34 ppb in winter, and hence no moderate or high exposure was predicted during either season. For summer conditions, the probability of low exposure to dissolved hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF, Moyne LGA, Bay of Islands and Childers Cove sub-LGAs) to 17% (Otway Plain IBRA, Colac Otway LGA, Cape Otway West sub-LGA and within Victoria State Waters)The Otway IMCRA recorded a probability of 50% during summer. During winter conditions, the probability of low exposure to dissolved hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF, Bay of Islands and Lorne sub-LGA) to 16% (within Victoria State Waters). The Otway IMCRA registered a probability of 42% for winter. None of the receptors were exposed to moderate (50 – 400 ppb) or high (>400 ppb) dissolved hydrocarbons (over a 48-hour basis) during the summer or winter season.
- At the depths of 0-10 m, the maximum dissolved hydrocarbon concentrations predicted over the 1-hour period was 309 ppb during summer and 289 ppb for winter, which occurred within the Otway IMCRA and the Victoria State Waters. During summer conditions, the probability of moderate exposure to

dissolved hydrocarbons ranged from 1% (Glenelg Plain and Bridgewater IBRA's; Glenelg, Moyne and Surf Coast LGAs; Lorne, Bay of Islands, Childers Cove and Cape Nelson sub-LGAs) to 43% (Otway Plain IBRA, Colac Otway LGA, Cape Otway West sub-LGA and within Victoria State Waters). The probability for Otway IMCRA was 58%. Under winter conditions, the probability of moderate exposure (over 1 hour) to dissolved hydrocarbons ranged from 1% (Gippsland Plain IBRA; Flinders IMCRA; Point Addis and Wilsons Promontory MNP; Mornington Peninsula LGA; Lorne, Mornington Peninsula and Childers Cove sub-LGAs) to 57% for the Victorian State Waters. The probability of exposure to the Otway IMCRA was 68%. None of the receptors were exposed high concentrations during the summer or winter season.

- The maximum entrained hydrocarbon concentrations time-averaged over 48 hours for the summer and winter season was 559 ppb and 569 ppb, respectively. No moderate or high exposure was predicted for any of the receptors predicted for any of the seasons. During summer conditions, the probability of low exposure to entrained hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF; Moyne LGA; Bay of Islands and Childers Cove sub-LGAs) to 17% (Otway Plain IBRA; Colac Otway LGA; Cape Otway West sub-LGA and within Victorian State Waters), with the exception of IMCRA – Otway (50%). During winter conditions, the probability of low exposure to entrained hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF; Bay of Islands and Lorne sub-LGAs) to 16% (Victoria State Waters), with the exception of Otway IMCRA (42%).
- Within the 0-10 m depth layer, the maximum concentration of entrained hydrocarbons over 1 hour was 948 ppb during summer and 932 ppb during winter, occurring within the Otway IMCRA. During summer conditions, the probability of moderate entrained hydrocarbon exposure ranged from 7% (Cape Patton sub-LGA) to 73% (Victorian State Waters). The probability of exposure to the Otway IMCRA receptor was 100% during both seasons. For other receptors during winter conditions, the probability of moderate entrained hydrocarbon exposure ranged from 8% (along the shoreline of Childers Cove sub-LGA; Moyne and Warrnambool LGA) to 73% (within Victorian State Waters).

RPS

1 INTRODUCTION

Beach Energy[1] is seeking approval to undertake further development of the Otway offshore natural gas reserves. The proposed development will include the drilling of offshore exploration wells situated in the Otway Basin starting with the Artisan-1 gas exploration well. In order to obtain environmental approvals for the drilling program, Beach Energy commissioned RPS to undertake a comprehensive oil spill modelling based on the following two hypothetical spill scenarios:

- 300 m^3 surface release of marine diesel over 6 hours in the event of a containment loss from a vessel at the Artisan-1 well location; and
- 222,224 bbl subsea release of condensate over 86 days to represent an unrestricted open-hole loss of well control (LOWC) event from the Artisan-1 well location.

Figure 1 and Table 1 present the location and coordinates of Artisan-1 which was used as the release location for the two scenarios.

The potential risk of exposure to the surrounding waters and contact to shorelines was assessed for summer (October to March) and winter (April to September) conditions. This approach assists with identifying the environmental values and sensitivities that would be at risk of exposure on a seasonal basis.

The purpose of the modelling is to further improve understanding of a conservative 'outer envelope' of the potential area that may be affected in the unlikely event of hydrocarbon release. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent that the released hydrocarbon may influence.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Mapping Analysis Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

The hydrocarbon spill model, the method and analysis applied herein uses modelling algorithms which have been peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Table 1 Location of the Artisan-1 well location used for the oil spill modelling study.

Well location	Latitude	Longitude	Water Depth (m)
Artisan-1	38° 53" 29.4' S	142° 52" 55.7' E	60

[1] It should be noted that Beach Energy is the 100% owner of Lattice Energy. Lattice Energy are the permit titleholder.

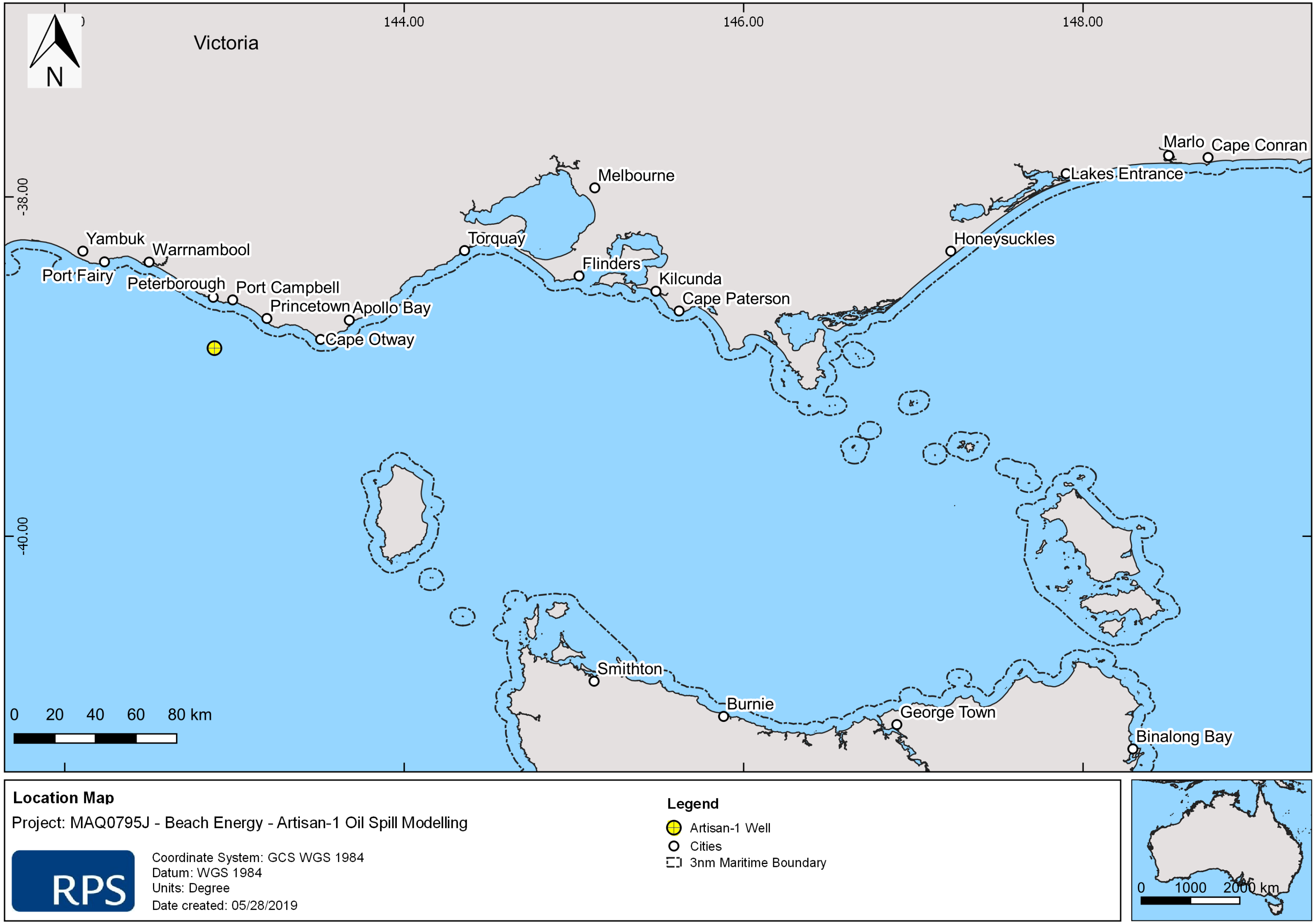

Figure 1 Locality map of the Artisan-1 exploration well.

2 SCOPE OF WORK

The scope of work included the following components:

1. Generate tidal current patterns of the region using the ocean/coastal model, HYDROMAP;
2. Use HYCOM (Hybrid Coordinate Ocean Model) ocean currents combined with HYDROMAP tidal currents over a 5-year period (2008 to 2012) to account for large scale flows offshore and tidal flows nearshore;
3. Use 5 years of high-resolution wind, aggregated current data and oil characteristics as input into the 3-dimensional oil spill model SIMAP to represent the movement, spreading, entrainment, weathering of the oil over time; and
4. Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surrounding waters (sea surface and water column) and shorelines; and
5. Undertake a high-level deterministic analysis of the "worst case" LOWC scenario.

3 REGIONAL CURRENTS

Bass Strait is a body of water separating Tasmania from the southern Australian mainland, specifically the state of Victoria. The strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Currents within the straight are primarily driven by tides, winds, incident continental shelf waves and density driven flows; high winds and strong tidal currents are frequent within the area (Jones, 1980).

The Otway Basin is part of the western field of the Bass Strait and lies along a north-west to south-east axis. It is approximately 500 km long and extends from Cape Jaffa in South Australia to north-west Tasmania and forms part of the Australian Southern Rift System.

The varied geography and bathymetry of the region, in addition to the forcing of the south-eastern Indian Ocean and local meteorology lead to complex shelf and slope circulation patterns (Middleton & Bye, 2007). Figure 2 displays seasonal surface current trends within the Bass Strait. During winter there is a strong eastward water flow due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery & Kampf 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward in offshore waters.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining deep ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with 2-dimensional tidal currents developed by RPS. The following sections provide a summary of the hybrid regional data set.

RPS

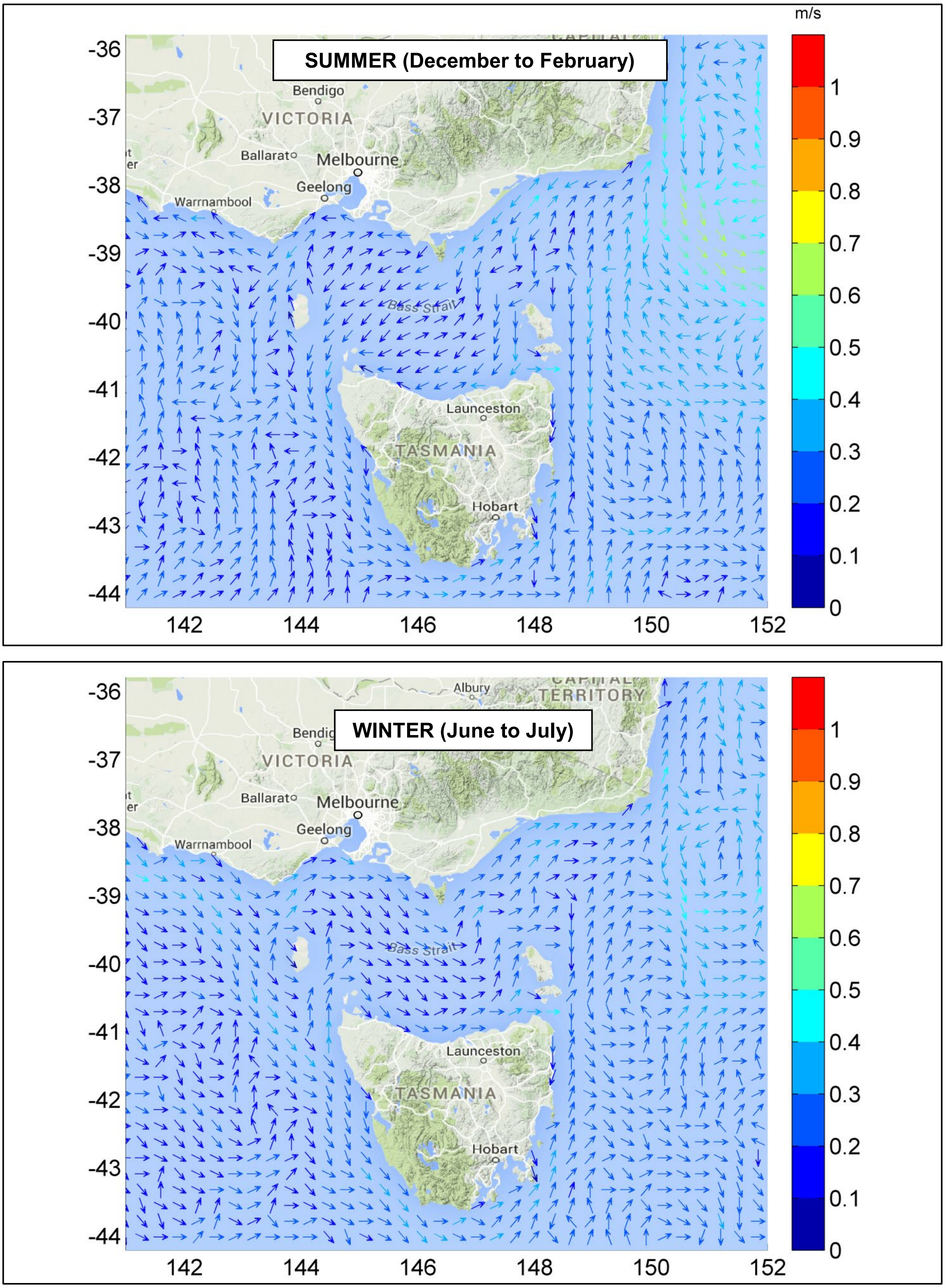

Figure 2 HYCOM averaged seasonal surface drift currents during summer and winter.

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3.1 Tidal Currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world over the past 32 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of particular interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain has been sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids were allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over regions with more complex bathymetry. Figure 3 shows the tidal model grid covering the study domain.

A combination of datasets were used and merged to describe the shape of the seabed within the grid domain (Figure 4). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

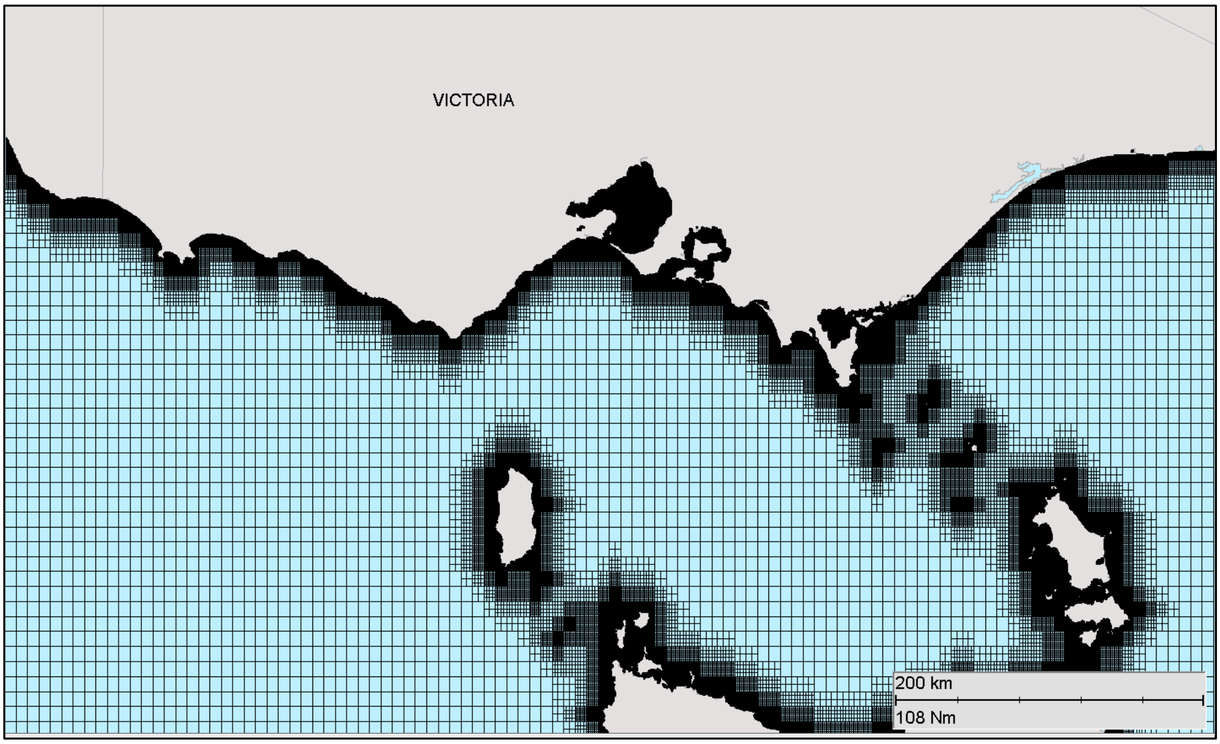

Figure 3 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

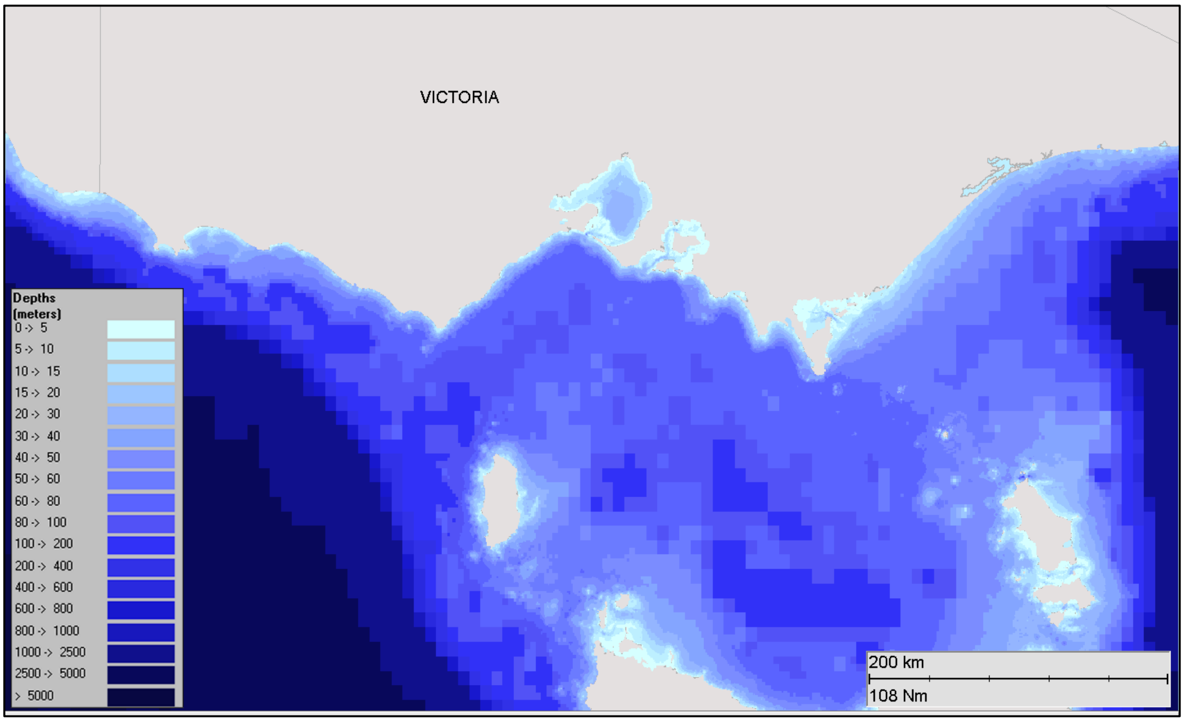

Figure 4 Bathymetry defined throughout the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 7.2) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, surface heights were firstly calculated along the open boundaries, at each time step in the model.

The TOPEX/Poseidon satellite data has a global resolution of 0.25 degrees and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The satellites equipped with two highly accurate altimeters and capable of taking sea level measurements with an accuracy of ± 5 cm measured oceanic surface elevations (and the resultant tides) for over 13 years (1992–2005). In total, these satellites carried out 62,000 orbits of the planet.

The TOPEX/Poseidon tidal data has been widely used amongst the oceanographic community, being included in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk and Tangdong, 2004; Qiu and Chen 2010). As such the TOPEX/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at five locations (see Figure 5).

To provide a statistical measure of the model performance, the Index of Agreement (IOA - Willmott (1981)) and the Mean Absolute Error (MAE - Willmott (1982) and Willmott and Matsuura (2005)) were used.

The MAE (Eq.1) is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood. The MAE is determined by:

$$MAE = N^{-1} \sum_{i=1}^{N} |P_i - O_i| \qquad \text{Eq.1}$$

Where: N = Number of observations

P_i = Model predicted surface elevation

O_i = Observed surface elevation

The Index of Agreement (IOA; Eq. 2) in contrast, gives a non-dimensional measure of model accuracy or performance. A perfect agreement between the model predicted and observed surface elevations exists if the index gives an agreement value of 1, and complete disagreement between model and observed surface elevations will produce an index measure of 0 (Wilmott, 1981). Willmott et al (1985) also suggests that values larger than 0.5 may represent good model performance. The IOA is determined by:

$$IOA = 1 - \frac{\sum |X_{model} - X_{obs}|^2}{\sum (|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2} \qquad \text{Eq.2}$$

Where: X_{model} = Model predicted surface elevation

X_{obs} = Observed surface elevation

Clearly, a greater IOA and lower MAE represent a better model performance.

Figure 6 and Figure 7 illustrate a comparison of the predicted and observed surface elevations for each location for January 2014. As shown on the graph, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles. Table 2 shows the statistical comparison between the observed and predicted surface elevations. For all of the stations, the IOA is well within the limits highlighting a good model performance. Hence, the tidal model predictions are considered accurate for this study.

Table 2 Statistical comparison between the observed and predicted surface elevations.

Tide Station	IOA	MAE (m)
Gabo Island	0.98	0.08
Port MacDonnell	0.98	0.05
Port Welshpool	0.92	0.30
Portland	0.97	0.07
Gabo Island	0.96	0.22

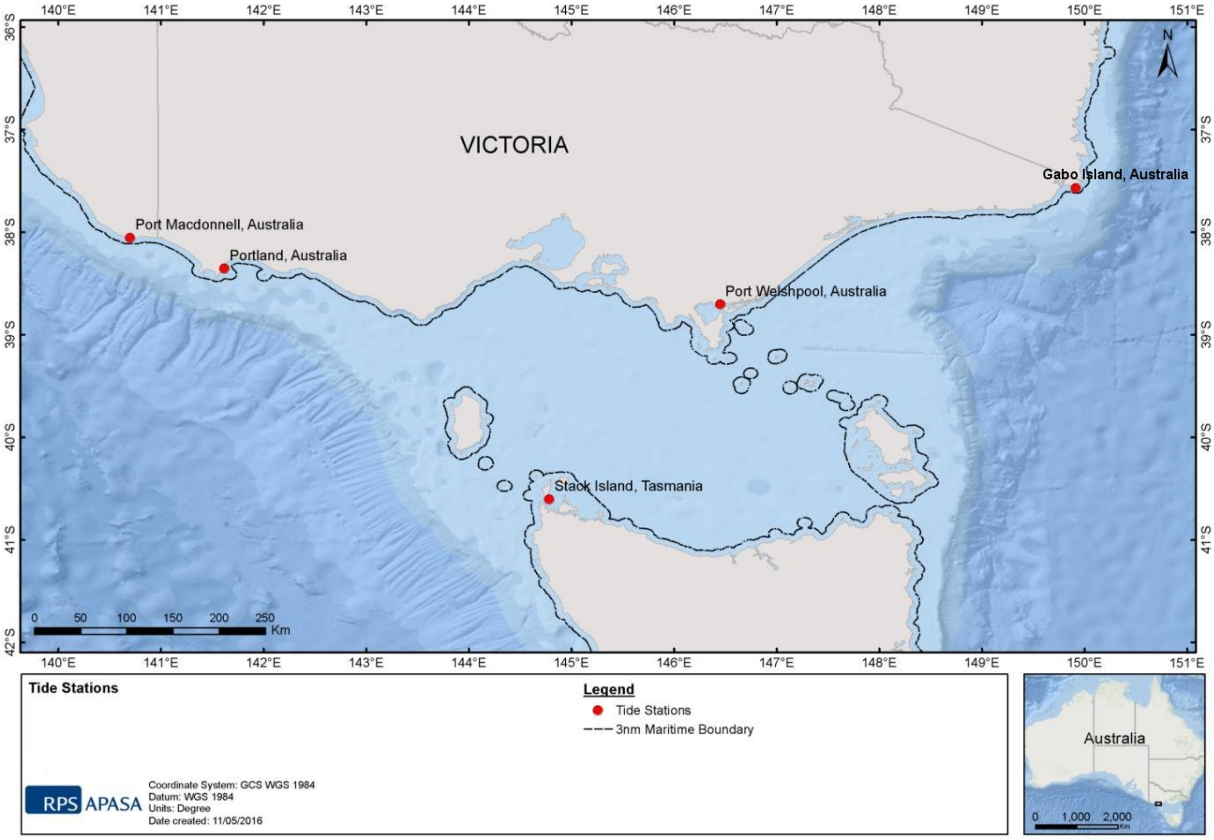

Figure 5 Tide stations used to calibrate surface elevation within the model.

Figure 8 is a snapshot of the predicted tidal current vectors.

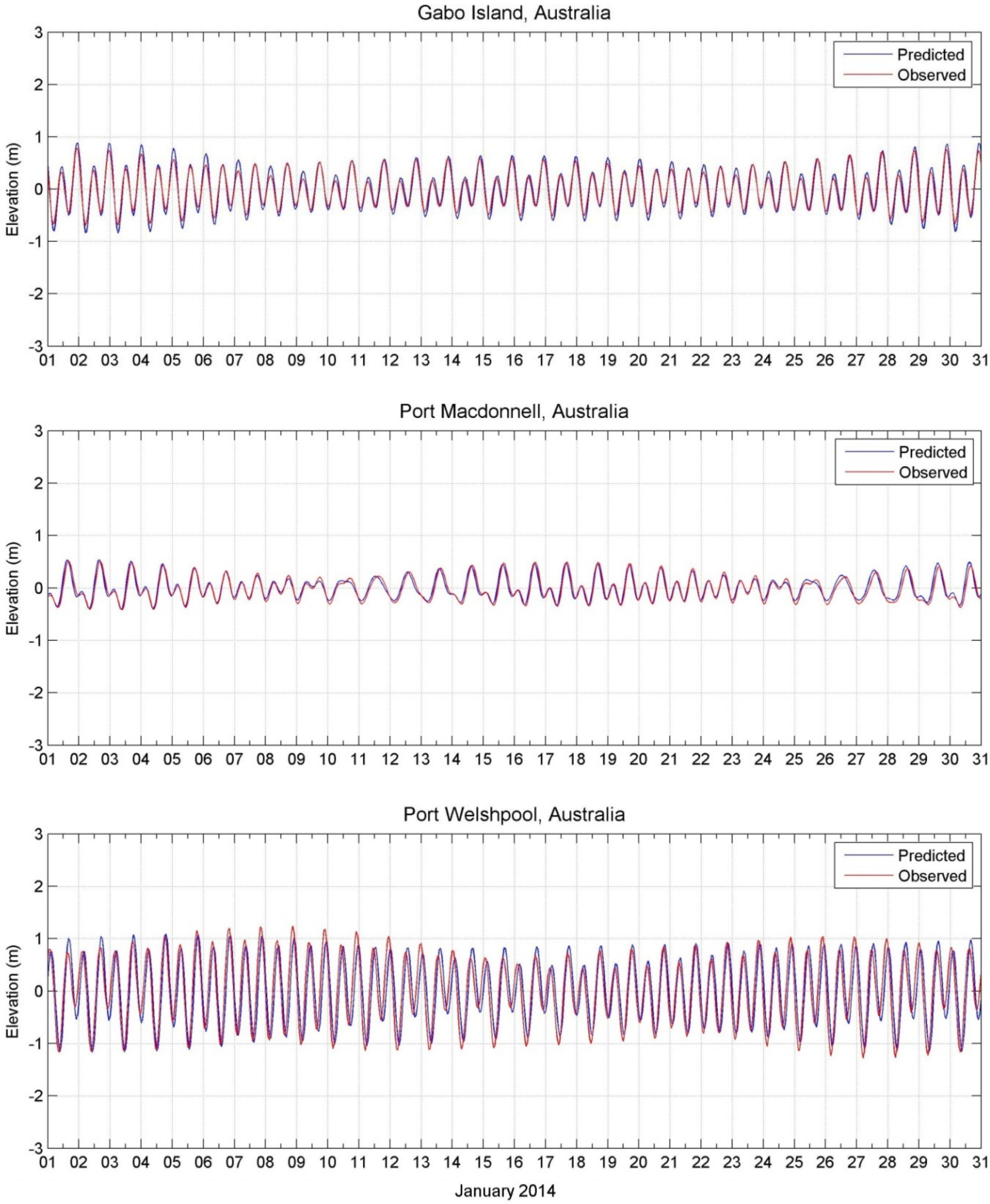

Figure 6 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Gabo Island (upper image), Port MacDonnell (middle image) and Port Welshpool (lower image).

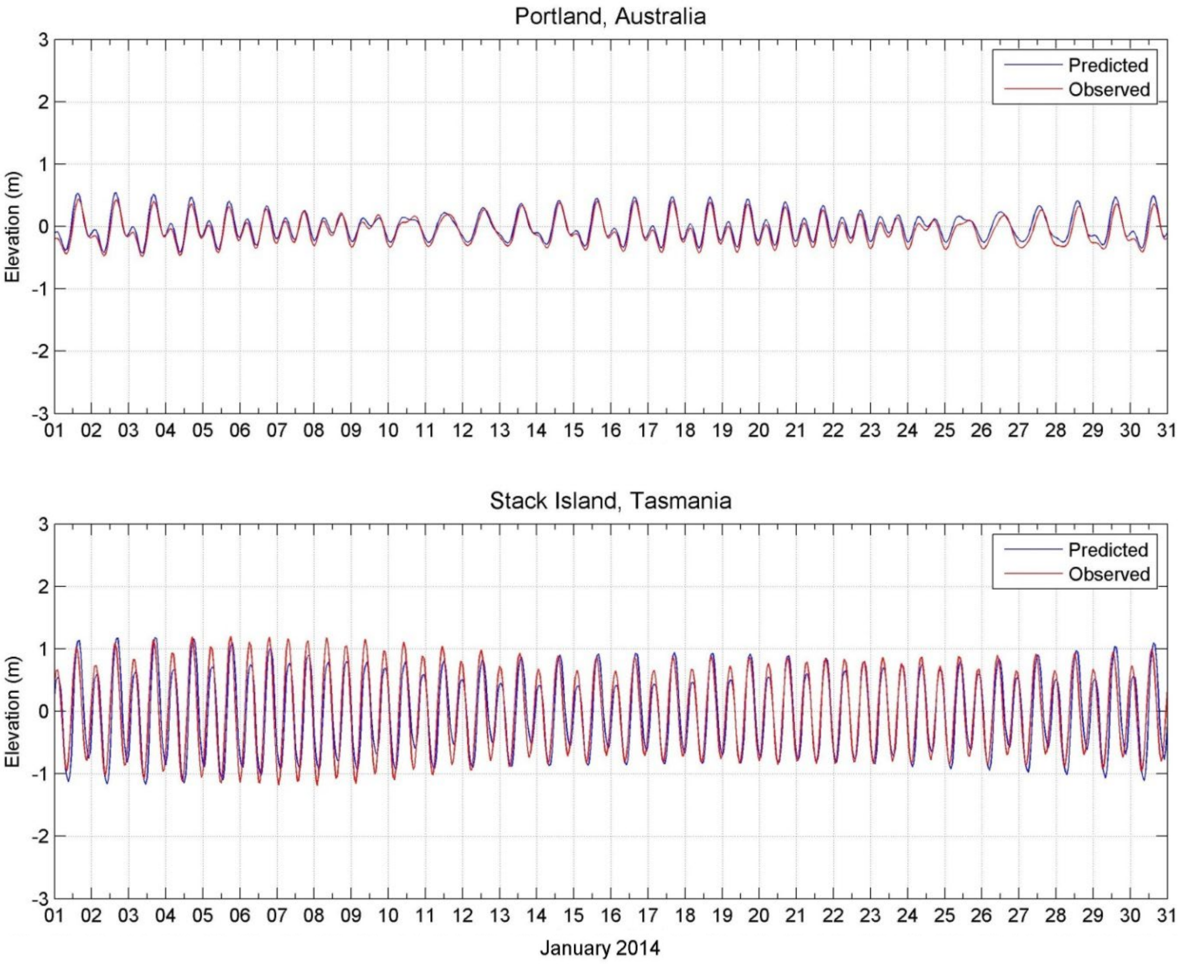

Figure 7 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Portland (upper image) and Stack Island (lower image).

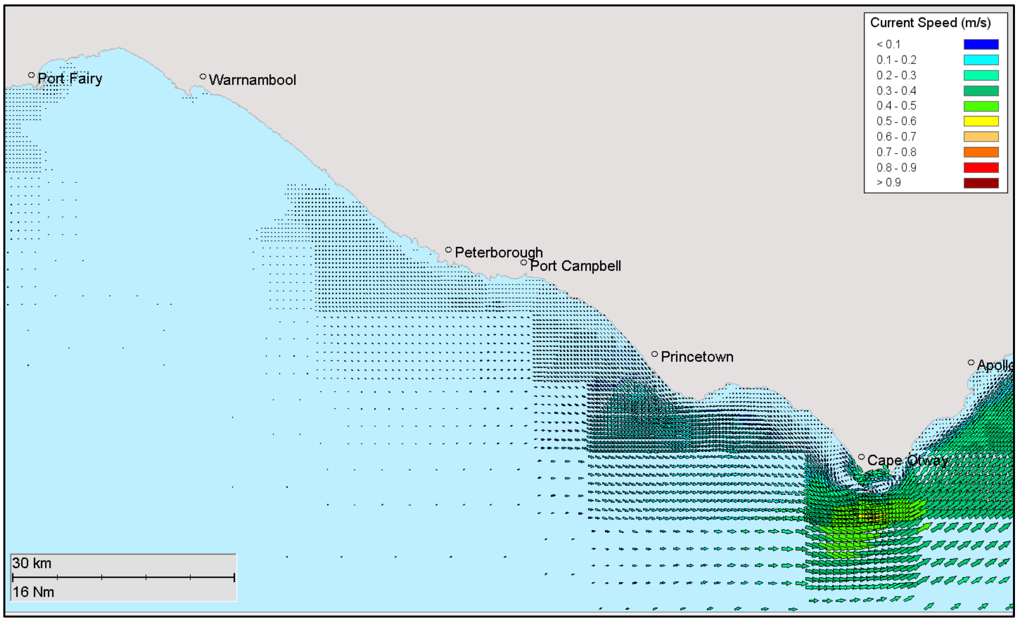

Figure 8 Snapshot of the predicted tidal current vectors. Note the density of the tidal vectors vary with the grid resolution, particularly along the coastline and around the islands and sholas.

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3.2 Ocean Currents

Data describing the flow of ocean currents was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

For this study, the HYCOM reanalysis hindcast currents were obtained for the years 2008 to 2012 (inclusive). Five years of data has been found to be suitably sufficient to account for the inter-annual variations and conditions with Bass Strait.

3.3 Surface Currents at the release site

Table 3 displays the predicted average and maximum surface current speed near the release location. Figure 9 and Figure 10 illustrate the monthly and seasonal current rose distributions (2008-2012 inclusive) derived from combining HYCOM ocean current data and HYDROMAP tidal data, respectively.

Note the convention for defining current direction throughout this report is the direction the current flows towards. Each branch of the current rose distribution represents the currents flowing to that direction, with north to the top of the diagram. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment within a branch is proportional to the frequency of currents flowing within the corresponding speed and direction.

The combined current data (ocean plus tides) indicated that during April to December the currents predominately flowed east and west during January to March. Monthly average surface current speed was similar throughout the year (0.16 to 0.25 m/s), while the maximum surface current speed ranged between 0.60 m/s (November and January) and 1.22 m/s (July).

RPS

Table 3 Predicted monthly average and maximum surface current speeds adjacent to the release location. Data derived by combining the HYCOM ocean data and HYDROMAP high resolution tidal data from 2008-2012 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction (towards)
January	0.17	0.60	WNW and ENE
February	0.18	0.69	WNW
March	0.16	0.85	WNW and ENE
April	0.16	1.20	E
May	0.16	0.78	E
June	0.22	0.99	E
July	0.22	1.22	E
August	0.25	1.01	ESE
September	0.22	0.90	E
October	0.18	0.68	E
November	0.17	0.60	E
December	0.19	0.68	E
Minimum	**0.16**	**0.60**	
Maximum	**0.25**	**1.22**	

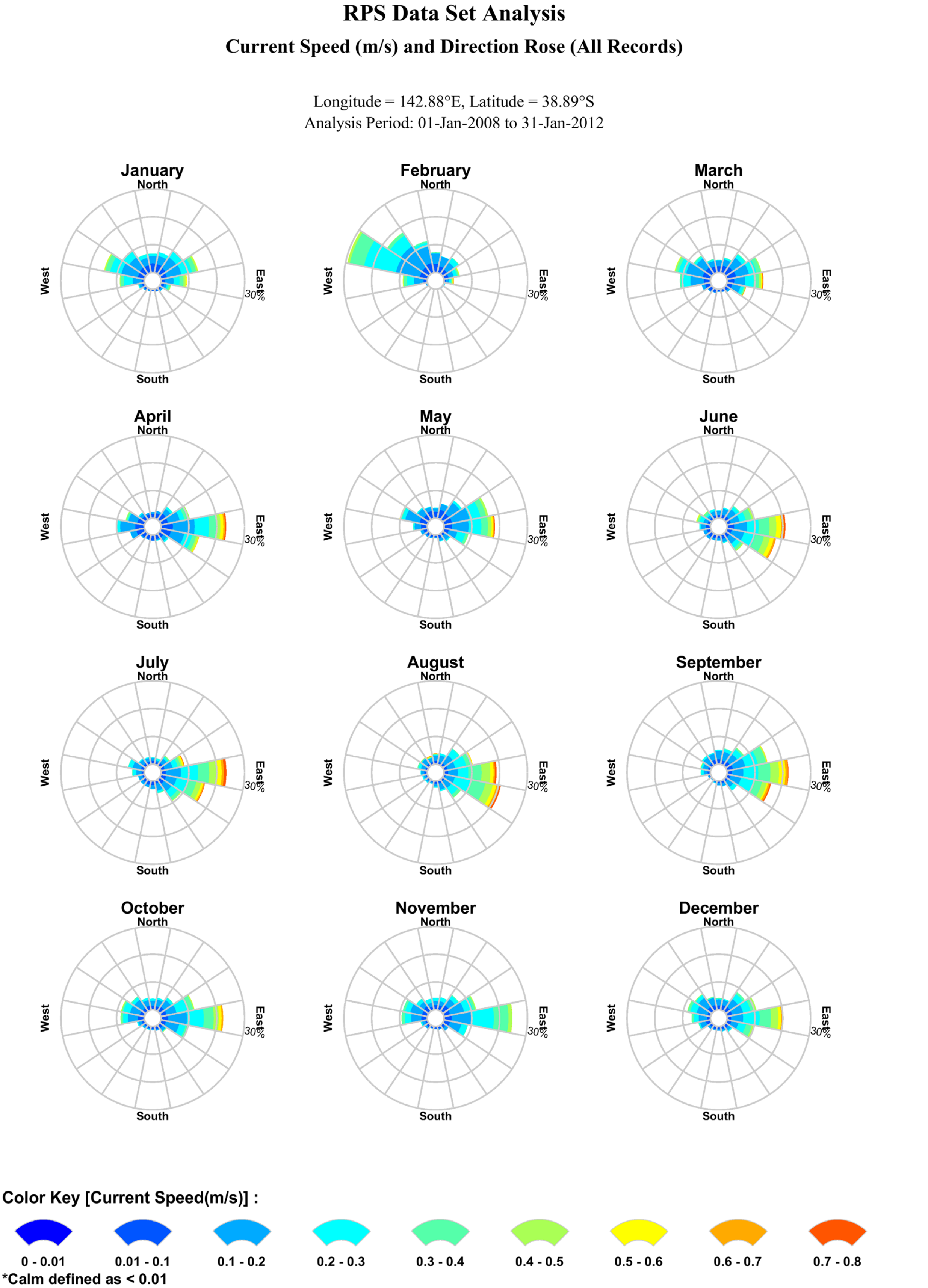

Figure 9 **Monthly surface current rose plots near the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2008 – 2012 inclusive).**

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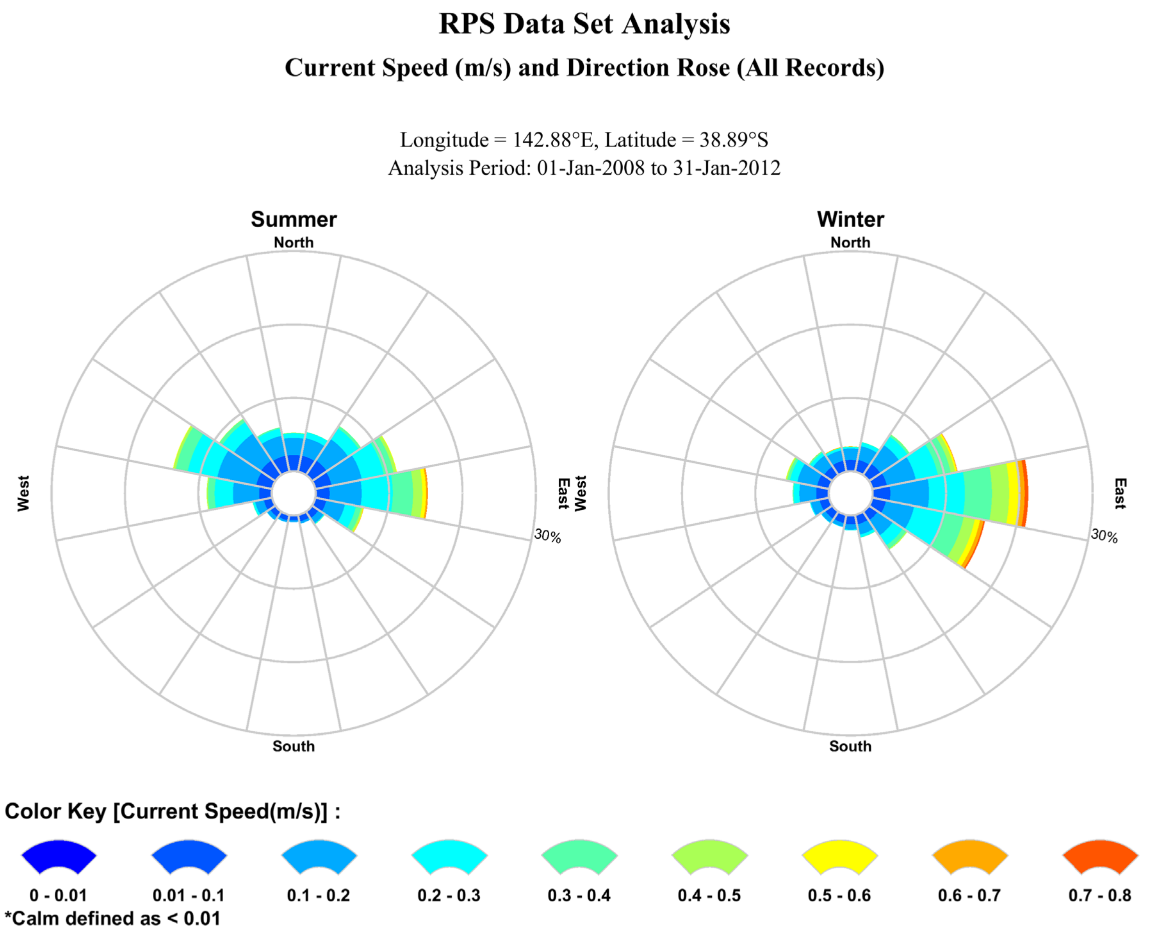

Figure 10 Seasonal surface current rose plots near the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2008 – 2012 inclusive).

4 WIND DATA

High resolution wind data was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR; see Saha et al., 2010) from 2008 to 2012 (inclusive).The CFSR wind model includes observations from many data sources; surface observations, upper-atmosphere air balloon observations, aircraft observations and satellite observations and is capable of accurately representing the interaction between the earth's oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 11 shows the spatial resolution of the wind field used as input into the oil spill model. Table 4 shows the monthly average and maximum winds derived from the CFSR node located adjacent to the release site. Figure 12 and Figure 13 show the monthly and seasonal wind rose distributions, respectively.

Note the convention for defining wind direction throughout this report is the direction the wind blows from. Each branch of the wind rose distribution represents wind coming from that direction, with north to the top of the diagram. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 3 knot intervals, excluding the calm and near calm conditions are used in these wind roses. The length of each coloured segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

The wind data analysis indicated that winds in the region are generally moderate to strong throughout the year, with a monthly average oscillating between ~13 knots (March) to ~18 knots (August). A maximum wind speed of 49 knots was recorded during September, while the lowest maximum speed of 34 knots occurred in December.

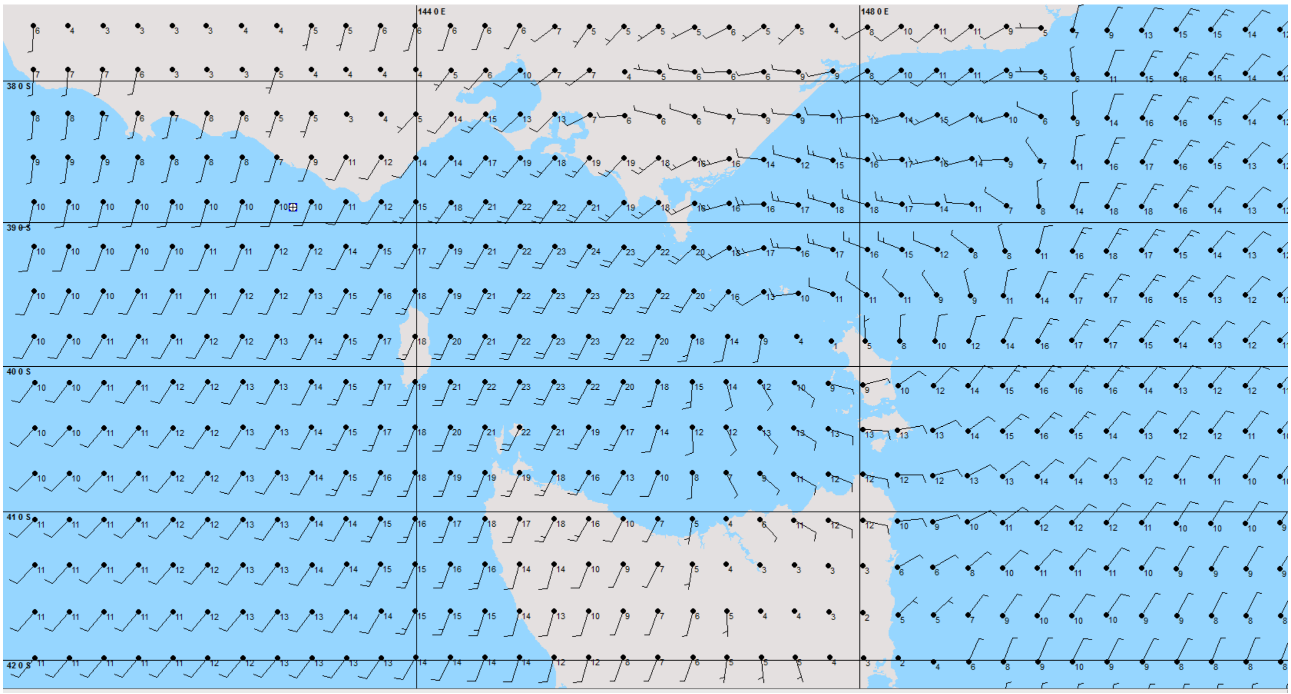

Figure 11 Image showing the CFSR modelled wind nodes.

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Table 4 Predicted monthly average and maximum winds for the wind node adjacent to the release location. Data derived from CFSR hindcast model from 2008-2012 (inclusive).

Month	Average wind (knots)	Maximum wind (knots)	General direction (from)
January	13	37	Variable SW to SE
February	14	37	SE
March	13	38	Variable
April	14	44	W
May	13	36	W
June	16	46	SW to NW
July	18	44	SW to NW
August	18	46	SW to NW
September	17	49	SW
October	14	35	SW to S
November	14	38	W to SE
December	14	34	W to E
Minimum	**13**	**34**	
Maximum	**18**	**49**	

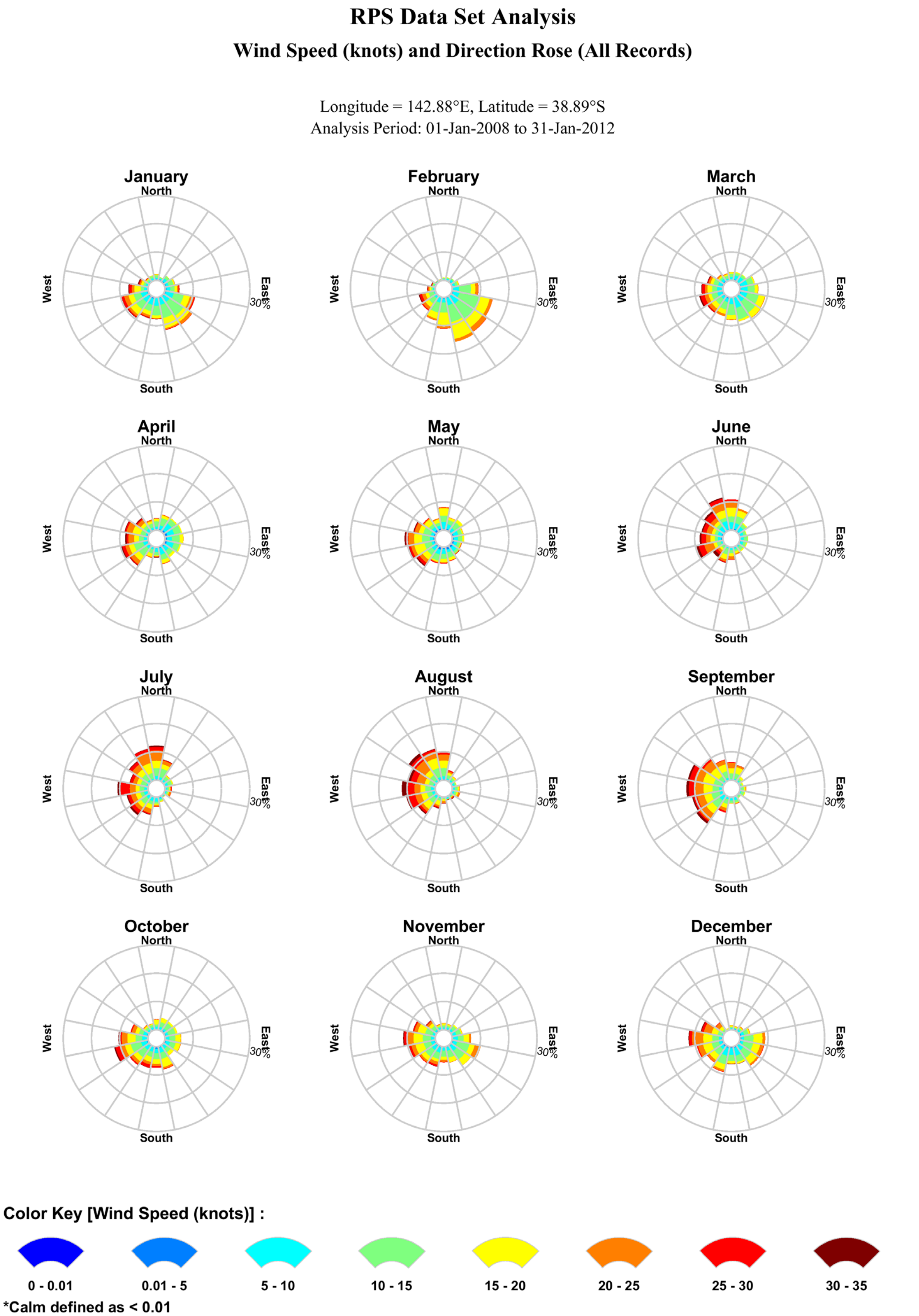

Figure 12 Monthly wind rose distributions derived from the CFSR hindcast model from 2008–2012 (inclusive), for the nearest wind node to the release location.

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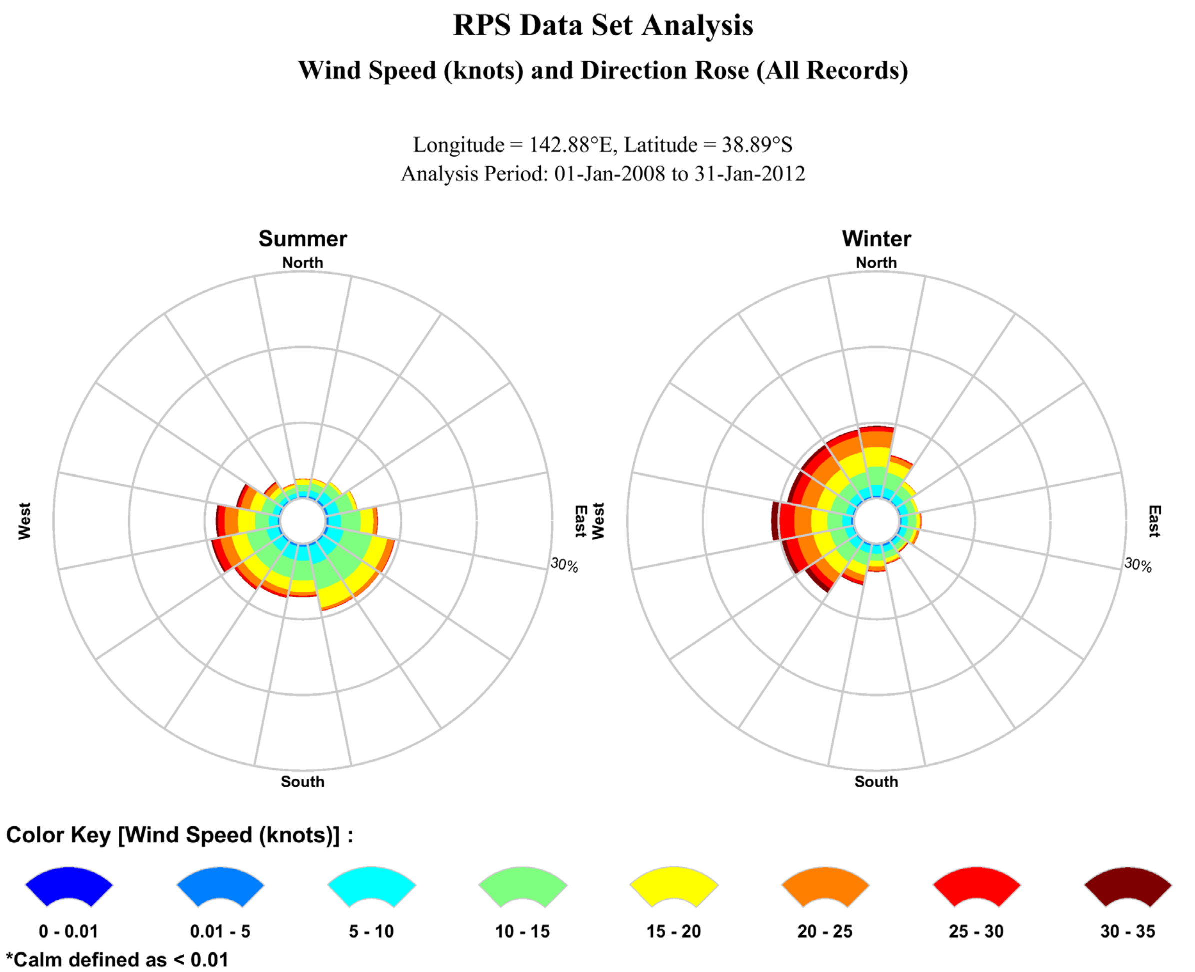

Figure 13 Seasonal wind rose distributions derived from the CFSR hindcast model from 2008–2012 (inclusive), for the nearest wind node to the release location.

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5 WATER TEMPERATURE AND SALINITY

The monthly depth-varying water temperature and salinity profiles at 5 m intervals through the water column adjacent to the release location (refer to Figure 14) was obtained from the World Ocean Atlas 2013 (WOA13) produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) (see Levitus et al., 2013). The data is to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and subsurface layers.

Table 5 summarises the monthly average sea surface temperatures and salinity (0-5 m depth layer). The sea surface temperatures were shown to range from 13.3°C (September) and 18.0°C (January). Salinity remained consistent throughout the year ranging from 35.1 to 35.6 psu.

Table 5 Monthly average sea surface temperature and salinity in the 0–5 m depth layer near the Artisan-1 well location.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	18.0	17.2	17.9	16.4	16.3	16.0	14.9	13.6	13.3	14.6	14.4	16.1
Salinity (psu)	35.4	35.1	35.4	35.4	35.4	35.4	35.6	35.3	35.3	35.4	35.4	35.4

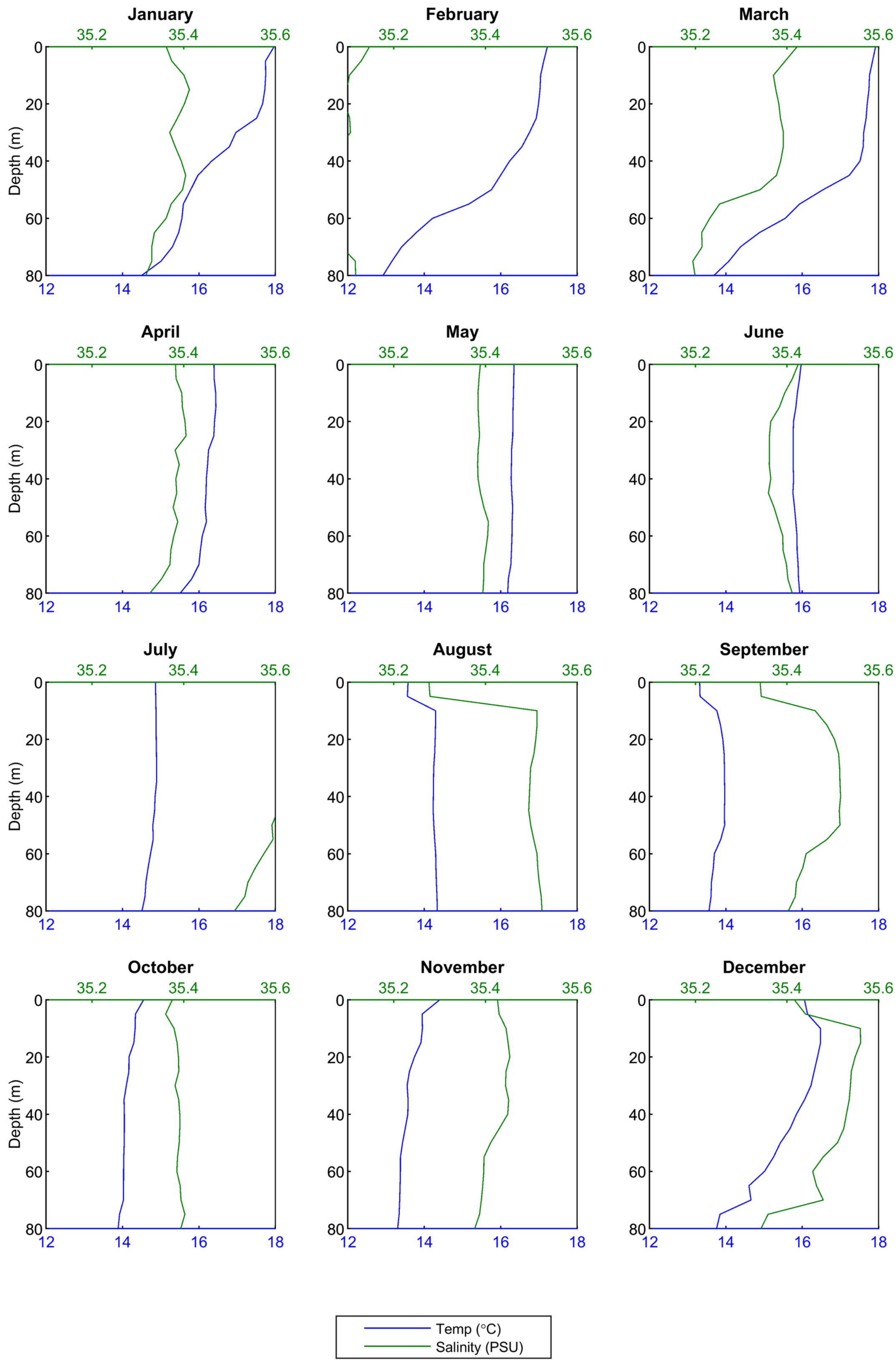

Figure 14 Monthly water temperature and salinity profiles near the release location.

6 NEAR-FIELD MODEL – OILMAP-DEEP

Near-field modelling was carried out for the loss of well control scenario to better understand the plume dynamics due to the amalgamation of condensate and gas at the seabed using the advanced OILMAP-DEEP blowout model. OILMAP-DEEP was developed by RPS and designed to provide the near-field behaviour of multi-phase gas-condensate plumes during subsurface blowout releases.

The model simulates the plume rise dynamics in two phases, the initial jet phase and the buoyant plume phase. The initial jet phase governs the plume dynamics directly above the subsea release location and is predominantly driven by the exit velocity. During this phase, the condensate droplet size and distribution are calculated. Next, the rise dynamics are dominated by the buoyant nature of the plume until the termination of the plume phase (known as the trapping depth). At this point, the results from OILMAP-DEEP (including plume trapping depth, plume diameter and droplet size distribution) are integrated into the far-field model SIMAP to simulate the rise and dispersion of the condensate droplets.

More details on the OILMAP-DEEP model, can be found in Spaulding et al. (2015). The model has been validated against observations from Deepwater Horizon as well as small and large-scale laboratory studies on subsurface oil releases (Brandvik et al 2013, 2014; Belore 2014; Spaulding et al. 2015; Li et al. 2017). Figure 15 illustrates the various stages of an example blowout plume.

Table 6 presents the input parameters and key results of the subsea modelling. Note that a depleting release rate illustrated in Figure 16 was used for the LOWC scenario, starting from 3,758 bbl/day on day 1 and decreasing to 1,718 bbl/day on day 86. The near-field modelling showed that in the event of a blowout from a well, the gas/liquid will propel the condensate upward from the seabed and the plume would rupture the sea surface. Due to the velocity of the plume, the model predicted droplet sizes would be relatively small, ranging from 100 to 400 µm.

Table 6 Input characteristics and key results from the subsea modelling.

Input Variable	Value
Scenario	86-day loss of well control
Water depth (m)	60
Tubing diameter (inch)	8.5”
Condensate Rate (stb/day)	3,758 bbl (day 1) depleting to 1,718 bbl (day 86)
Water Rate (stb/day)	189 bbl (day 1) depleting to 137 bbl (day 86)
Gas Rate (scf/day)	290,000,000 scf (day 1) depleting to 132,000,000 scf (day 86)
Gas to Condensate ratio (scf/bbl)	81,727 (average)
Gas to Total Liquids ratio (scf/bbl)	76,868 (average)
Reservoir temperature (°C)	93
Release Pressure (psia)	2,583 (day 1) depleting to 256 (day 86)
Key Results	
Plume execution depth (m)	Plume ruptures the sea surface
Droplet Sizes	100 – 400 µm

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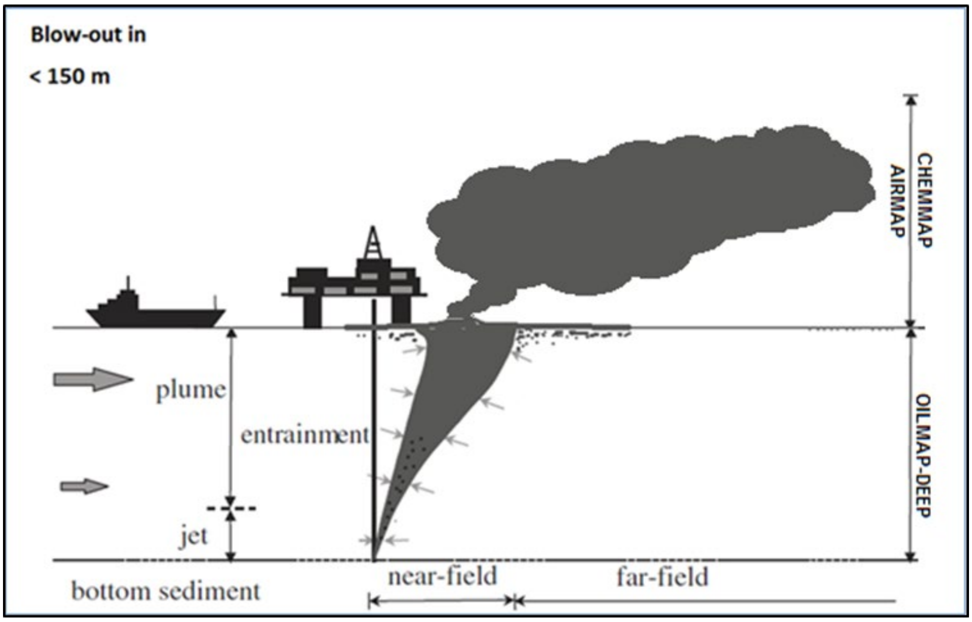

Figure 15 Example of a blowout plume illustrating the various stages of the plume in the water column (Source: Applied Science Associates, 2011).

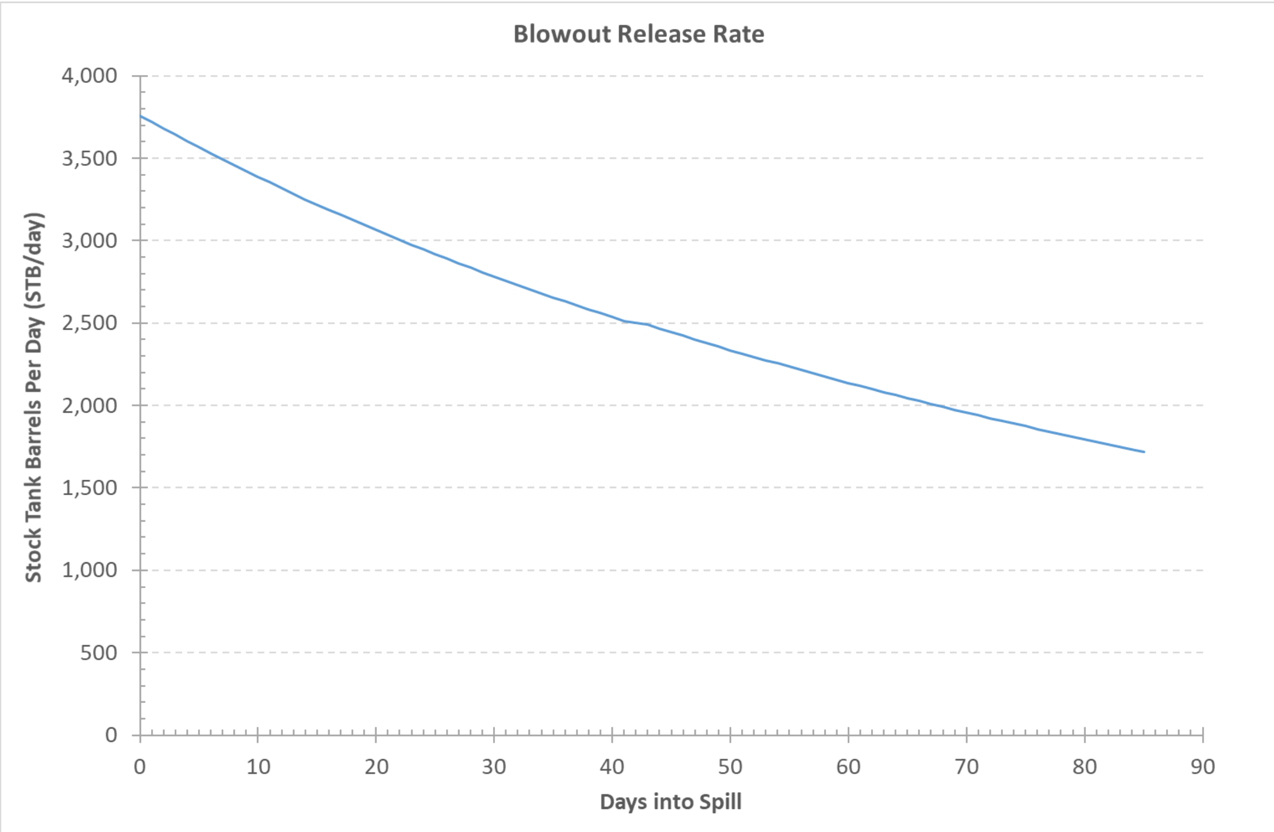

Figure 16 Depleting release rate used for the LOWC scenario

7 OIL SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using SIMAP. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al. 1994; French et al. 1999; French-McCay, 2003; French-McCay, 2004; French-McCay et al. 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point ranges. The SIMAP model uses an interpolation scheme based on an area-weighting scheme of the four nearest points of the wind and currents from the oil particle location.

SIMAP is a 3D model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil, and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

7.1 Stochastic Modelling

Stochastic oil spill modelling is created by overlaying a great number (often 100 hundred) simulated hypothetical oil spills (e.g. Figure 17). Stochastic modelling involves running numerous individual oil spill simulations using a range of prevailing wind and current conditions that are historically representative of the season of where the spill event may occur.

For the stochastic modelling presented herein, 100 spills for each of season were simulated and each using the same spill information (release location, spill volume, duration and oil type) but with varied start dates and times corresponding to the period represented by the available wind and current data. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations were analysed to determine the following statistics for every grid cell:

- Exposure load (concentrations and volumes);
- Minimum time before exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may strand on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines; and
- Exposure (concentration x duration of exposure) to entrained and dissolved hydrocarbons in the water column.

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Exposure (concentration x duration of exposure) to entrained and dissolved hydrocarbons in the water column

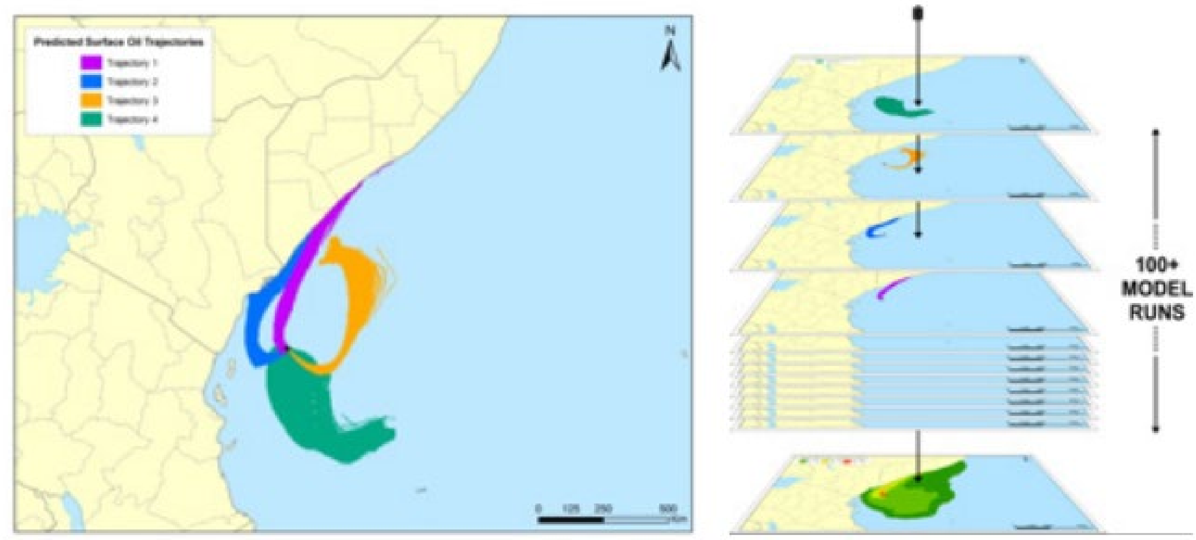

Figure 17 Predicted movement of four single oil spill simulations predicted by SIMAP for the same scenario (left image). All model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

7.2 Sea surface, Shoreline and In-Water Exposure Thresholds

The thresholds for the sea surface, shoreline and water column (entrained and dissolved hydrocarbons) is presented in Table 7 and their relationship to exposure, are presented in Sections 7.2.1 to 7.2.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of influence are also provided. It is important to note that the thresholds are in line with the thresholds recommended in the NOPSEMA oil spill modelling bulletin April 2019 (https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf), In some instances, slightly more conservative. For example, the low surface exposure of >0.5 g/m^2 was adopted in the study, while the NOPSEMA bulletin recommends 1 g/m^2.

Table 7 Exposure and contact threshold values used for the Artisan-1 oil spill modelling study.

Level	Sea Surface Exposure (g/m^2)	Shoreline Contact (g/m^2)	Dissolved Hydrocarbon Concentration (ppb)#	Entrained Hydrocarbon Concentrations (ppb)#
Low	0.5	10	6	10
Moderate	10	100	50	100
High	25	1,000	400	1,000

#These thresholds were assessed for a) 1 hour exposure and b) 48-hour exposure windows. Both sets of results are provided in the result section(s).

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7.2.1 Sea Surface Exposure Thresholds

The minimum sea surface reporting level for each spill simulation was 0.5 g/m^2, which equates to an average thickness of approximately 0.5 µm. Oil of this thickness is described as a rainbow to metallic sheen in appearance according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009, Table 8). This thickness is considered the minimum level for observing oil in the marine environment by the Australian Maritime Safety Authority (AMSA, 2015). Furthermore, this threshold is considered below levels which would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) according to French et al. (1996) and French-McCay (2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009). Concentrations above 10 g/m^2 is also considered the lower actionable threshold, where oil may be thick enough for containment and recovery as well as dispersant treatment (AMSA, 2015).

Scholten et al. (1996) and Koops et al. (2004) indicated that at oil concentrations on the sea surface of 25 g/m^2 (or greater), would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening. The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009).

The sea surface reporting thresholds applied in this study were 0.5–10 g/m^2 (low), 10–25 g/m^2 (moderate) and above 25 g/m^2 (high) (Table 7).

Note that the higher threshold applied in this study falls below the thickness that would begin to present as patches of true oil colour (Table 8).

Figure 18 shows examples of the differences between oil colour and corresponding thickness on the sea surface. Hydrocarbons in the marine environment may appear differently due the ambient environmental conditions (wind and wave action).

Table 8 Bonn Agreement Oil Appearance Code

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	200 –>	200,000 –>

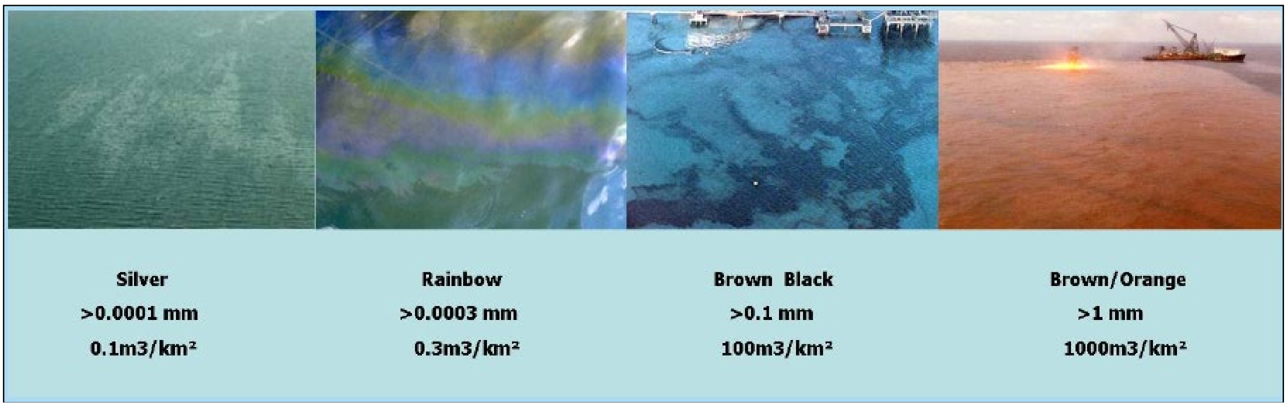

Figure 18 Photograph showing the difference between oil appearance on the sea surface (source: OilSpillSolutions.org, 2015).

The generic oil colour categories used in this report are meant as a guide only. For more accurate description of oil appearance on the sea surface a detailed analysis of an oil should be undertaken.

The specific oil type will determine appearance (i.e. colour) and behaviour on the sea surface. Lighter oils such as marine diesel and condensate, have true oil colours that are pale or transparent. As such, these oil types may not increase beyond a rainbow or metallic sheen, despite their thickness increasing beyond 25 g/m^2 (~25 um). Moreover, the physical properties and appearance of oil types will change due to weathering on the sea surface. For example, oils with high paraffinic wax content will form waxy sheets that break up into flakes or nodules after the more volatile components have evaporated. Take up of water by the oil (emulsification) will also significantly change the appearance and thickness of floating oil. Stable water-in-oil emulsions will have a higher combined mass and thickness and will present as thick, semi-solid, aerated layers that tend to be coloured strongly red/brown, orange or yellow, rather than the true oil colour.

It should be noted that in the case of solidified or emulsified oils, mass per area estimates cannot be directly referenced to the Bonn Agreement visibility scale that refers only to oil present as films or slicks of oil alone.

7.2.2 Shoreline Exposure Thresholds

The reporting threshold of 10 g/m^2 was applied as the visible limit for oil on shore. This threshold may trigger socio-economic impact, such as triggering temporary closures of beaches to recreation or fishing, or closure of commercial fisheries and might trigger attempts for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). In previous risk assessment studies, French-McCay et al (2005a; 2005b) used a threshold of 10 g/m^2, equating to approximately two teaspoons of oil per square meter of shoreline, as a low impact threshold when assessing the potential for shoreline exposure.

French et al. (1996) and French-McCay (2009) define a shoreline oil threshold of 100 g/m^2, or above, as having potentially harm shorebirds and wildlife (furbearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011, 2012; NOAA, 2013). Additionally, a shoreline concentration of 100 g/m^2, or above, is the minimum limit that the oil can be effectively cleaned according the AMSA (2015) guidelines. This threshold equates to approximately ½ a cup of oil per square meter of shoreline exposure. The appearance is described as a thin oil coat.

The higher threshold of 1,000 g/m^2, and above, was adopted to inform locations that might receive oil accumulation levels that could have a higher potential for ecological effect. Observations by Lin and Mendelssohn (1996), demonstrated that loadings of more than 1,000 g/m^2 of oil during the growing season

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would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing oil impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). This concentration equates to approximately 1 litre or 4 ¼ cups of fresh oil per square meter of shoreline exposure. The appearance is described as an oil cover.

The shoreline reporting thresholds applied in this study were 10–100 g/m^2 (low), 100–1,000 g/m^2 (moderate) and above 1,000 g/m^2 (high) (Table 7).

7.2.3 Dissolved and Entrained Hydrocarbon Thresholds

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

7.2.3.1 Dissolved hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed “bioavailable”.

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan &Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; Mackay et al., 1992; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath et al., 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2-3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb total PAH concentration after 96 hrs exposure, with an average of 50 ppb. Hence, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of time averaged exposure (based on 96 hours) at 6, 50 or 400 ppb was applied to indicate increasing potential for sub-lethal to lethal toxic effects (or low to high).

Furthermore, in accordance with the NOPSEMA oil spill modelling bulletin, the same thresholds were assessed over a 1 hour time step (see Table 7).

7.2.3.2 Entrained hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. As such, insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, hence are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2005).

The 10 ppb threshold represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more.

This exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.

Thresholds of 10 ppb, 100 ppb and 500 ppb were applied as time averaged exposure (over 96 hours, see Table 7), to cover the range of thresholds outlined in the ANZECC/ARMCANZ (2000) water quality guidelines and the incremental change for greater potential effect.

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

Furthermore, in accordance with the NOPSEMA oil spill modelling bulletin, the same thresholds were assessed over a 1 hour time step (see Table 7).

7.3 Oil Properties

7.3.1 Marine Diesel Oil

Marine Diesel Oil (MDO) is a light-persistent fuel oil used in the maritime industry. It has a density of 829.1 kg/m^3 (API of 37.6) and a low pour point (-14^{o}C). The low viscosity (4 cP) indicates that this oil will spread quickly when released and will form a thin to low thickness film on the sea surface, increasing the rate of evaporation. According to the International Tankers Owners Pollution Federation (ITOPF, 2014) and AMSA (2015a) guidelines, this oil is categorised as a group II oil (light-persistent).

Table 9 details the physical properties of MDO, while Table 10 presents the boiling point ranges of the MDO used in this study.

Figure 19 illustrates the weathering graph for a 300 m^3 release of MDO over 6 hours during three wind speeds. The 5, 10 and 15 knot wind speeds were selected given that breaking waves and in turn entrainment takes place between 10 – 12 knots. The results illustrate that the prevailing wind speeds can and do influence the weathering and fate of the MDO. Under lower wind-speeds (5 knots), the MDO will remain on the surface longer, spread quicker, and in turn greater evaporation. Conversely, sustained stronger winds (>15 knots) will generate breaking waves at the surface, causing a higher amount of MDO to be entrained into the water column and reducing the amount available to evaporate.

7.3.2 Thylacine Condensate

Thylacine condensate was used for the loss of well control scenario (Scenario 2). The condensate has an API of 44.3, density of 804.6 kg/m^3 at 15ºC) with low viscosity (0.875 cP) (refer to Table 9), classifying it as a Group I oil according to the (ITOPF, 2014) and USEPA/USCG classifications. The condensate comprises a significant portion of volatiles and semi to low volatiles (99% total) with very little residual components (<1%) (refer to Table 10). This means that the majority of the condensate will evaporate readily when on the water surface, with a minimal amount of persistent components to remain on the water surface over time.

Figure 1 displays the weathering graph for a 24-hour release (3,758 bbl) of Thylacine condensate during three static wind speeds. The weathering graph shows rapid evaporation occurs during the first 24 hours (while the condensate is still being released) during all three wind speeds. Thylacine condensate is predicted to readily entrain into the water column under the higher wind speeds (10 and 15 knots). Due to the high volatility of the condensate, little is predicted to remain on the water surface after the spill ceases.

Table 9 Physical properties of MDO and Thylacine condensate

Characteristic	MDO	Thylacine Condensate
Density (kg/m^3) at 15°C	829.1	804.6
API	37.6	44.3
Dynamic viscosity (cP) at 20°C	4	0.875
Pour Point (°C)	-14	-50
Wax content (%)	1	NA
Hydrocarbon property category	Group II	Group I
Hydrocarbon property classification	Light - Persistent	Non-persistent oil

Table 10 Boiling point ranges of MDO and Thylacine condensate

Characteristic	Not Persistent			Persistent
	Volatile	Semi-volatile	Low volatility	Residual
Boiling point (ºC)	< 180	180 - 265	265 - 380	>380
MDO	6.0	34.6	54.4	5.0
Thylacine condensate	64.0	19.0	16.0	1

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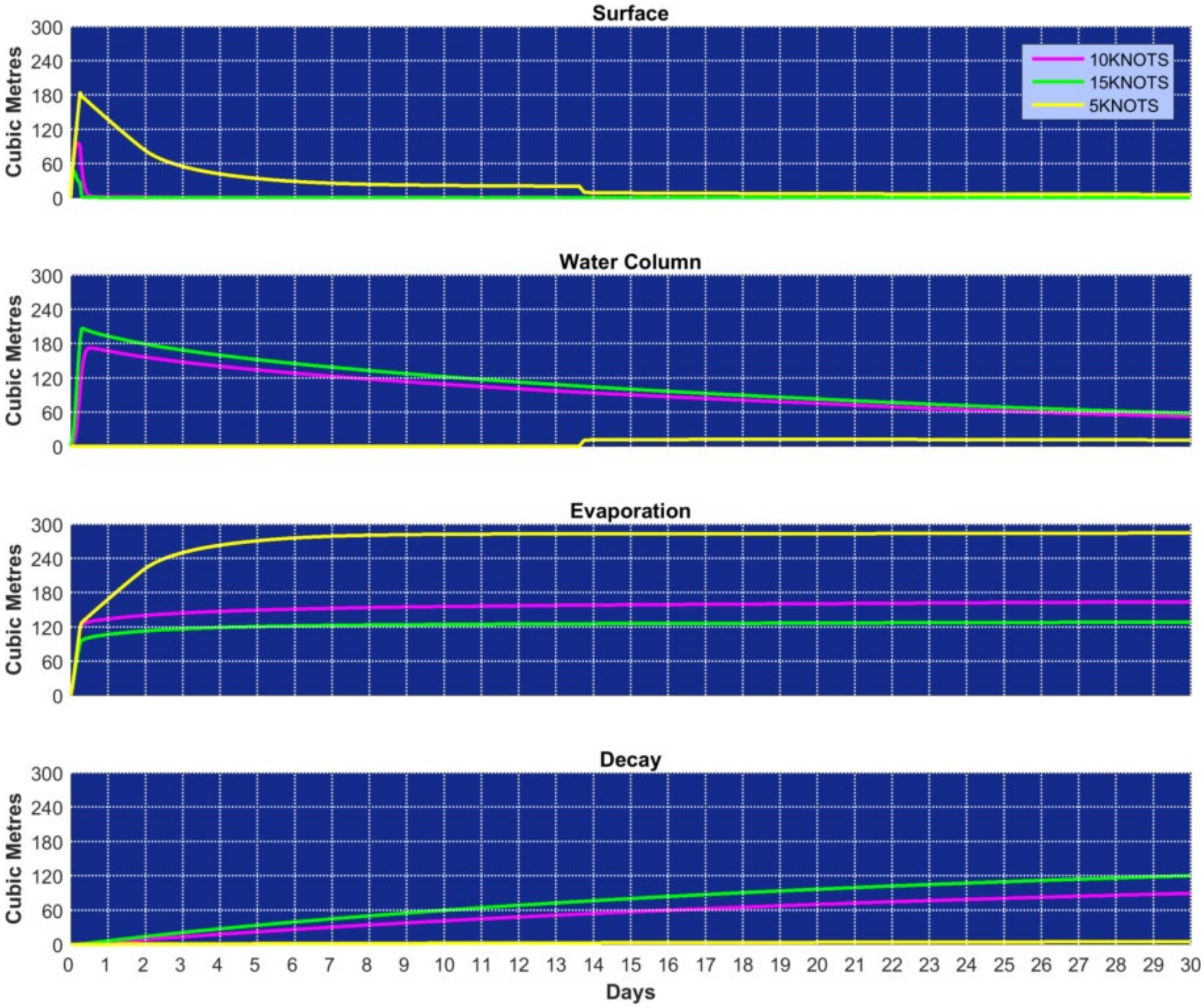

Figure 19 Weathering of a 300 m^3 surface release of MDO over 6 hours (tracked for 30 days) under three static winds conditions (5, 10 and 15 knots).

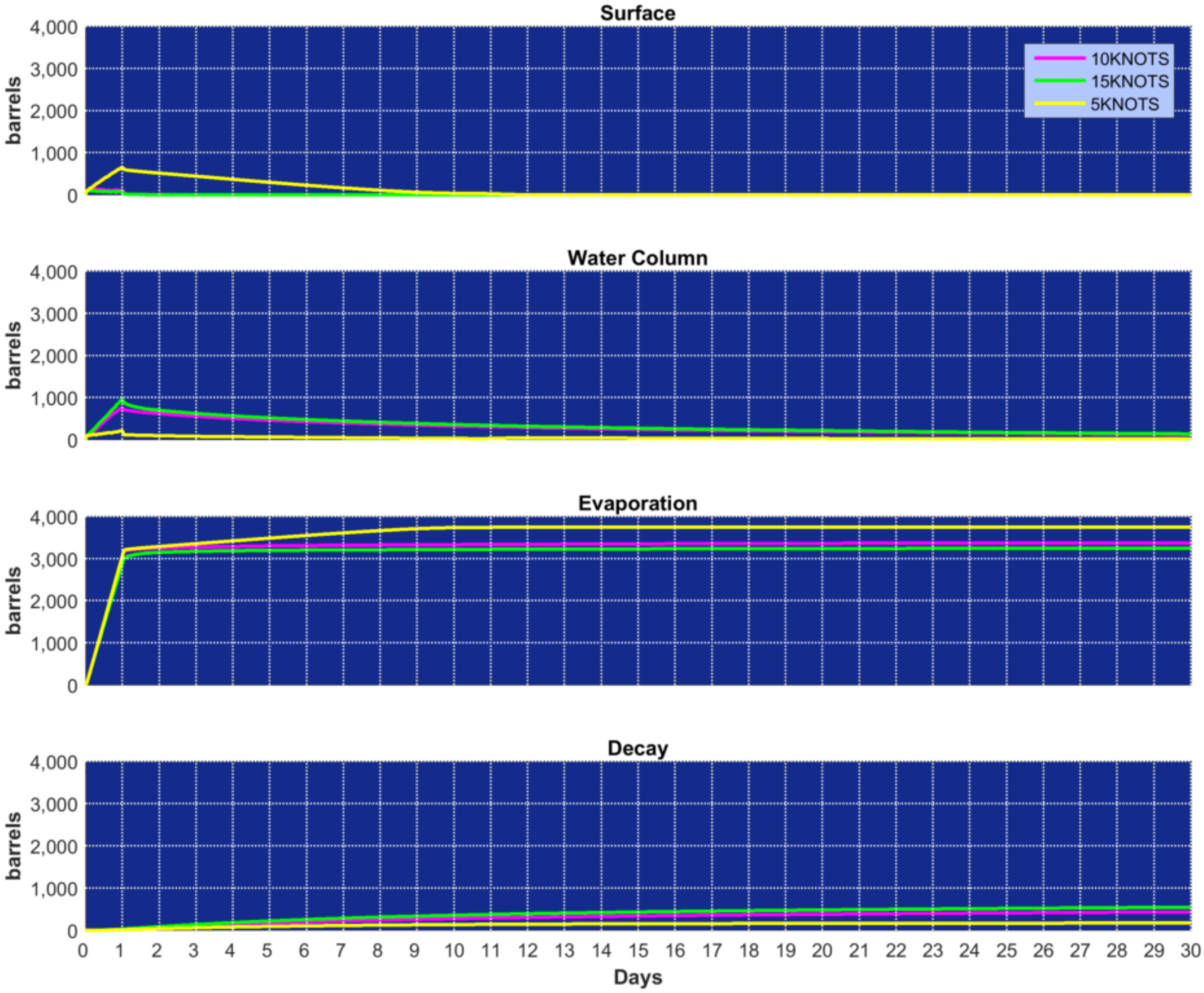

Figure 1 Weathering of 3,758 bbl subsea release of Thylacine condensate over 24 hours (tracked for 30 days) under three static wind speeds (5,10 and 15 knots).

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7.4 Model Settings

This oil spill modelling study quantified the seasonal risk and potential exposure to the surrounding waters and shorelines for two plausible, yet hypothetical scenarios:

- 300 m^3 surface release of marine diesel over 6 hours in the event of a containment loss from a vessel at the Artisan-1 well location; and
- 222,224 bbl subsea release of condensate over 86 days to represent an unrestricted open-hole loss of well control (LOWC) event from the Artisan-1 well location

Table 11 provides a summary of the oil spill model settings.

Table 11 Summary of the oil spill model settings

Parameter	Oil Spill Scenario	
Scenario description	Subsea Loss of Well Control	Loss of Containment from a Vessel
Model period	Summer (October to March) Winter (April to September)	
Number of randomly selected spill start times and locations per season	100 (200 total)	100 (200 total)
Oil type	Thylacine condensate	MDO
Spill volume	222,224 bbl	300 m^3
Release type	Subsea (60m)	Surface
Release duration	86 days	6 hr
Simulation length (days)	114	30
Surface oil concentration thresholds	0.5 g/m^2, 10 g/m^2, >25 g/m^2	
Shoreline load threshold	10 g/m^2, 100 g/m^2, >1,000 g/m^2	
Dissolved hydrocarbon exposure to assess the potential exposure (ppb). *These thresholds were assessed for 1 hour and 48-hour exposure windows.*	6 ppb, potential low exposure 50 ppb, potential moderate exposure 400 ppb, potential high exposure	
Entrained hydrocarbon exposure to assess the potential exposure (ppb). *These thresholds were assessed for 1 hour and 48-hour exposure windows.*	10 ppb, potential low exposure 100 ppb, potential moderate exposure 1,000 ppb, potential high exposure	

8 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of statistical tables, which aim to provide a comprehensive understanding of the predicted sea-surface and in-water (subsurface) exposure and shoreline contact (if predicted).

8.1 Seasonal Analysis

The seasonal analysis is presented in the form of statistical tables based on the following principles:

- The ***greatest distance travelled by a spill trajectory* –** is determined by a) recording the maximum and b) second greatest distance travelled (or 99th percentile) by a single trajectory, within a scenario, from the release location to the identified exposure thresholds.
- The ***probability of shoreline contact*** – is determined by recording the number of spill trajectories to contact the shoreline, at a specific threshold, divided by the total number of spill trajectories within that scenario.
- The ***minimum time before oil exposure*** – is determined by recording the minimum time for a grid cell to record exposure, at a specific threshold.
- The ***average volume of oil ashore for a single spill*** – is determined by calculating the average volume of the all the single spill trajectories which were predicted to make shoreline contact within a scenario.
- The ***maximum volume of oil ashore from a single spill trajectory*** – is determined by identifying the single spill trajectory within a scenario/season, that recorded the maximum volume of oil to come ashore and presenting that value.
- The ***average length of shoreline contacted by oil*** – is determined by calculating the average of the length of shoreline (measured as grid cells) contacted by oil above a specified threshold.
- The ***maximum length of shoreline contacted by oil*** – is determined by recording the maximum length of shoreline (measured as grid cells) contacted by oil above a specified threshold.
- The ***probability of oil exposure to a receptor* –** is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***minimum time before oil exposure to a receptor*–** is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.
- The ***probability of oil contact to a receptor* –** is determined by recording the number of spill trajectories to reach a specified shoreline contact threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***minimum time before shoreline contact to a receptor* –** is determined by ranking the elapsed time before shoreline contact, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.
- The ***average potential oil loading within a receptor*** – is determined taking the average of the maximum loading to any grid cell within a polygon, for all simulations within a scenario/season, that recorded shoreline.
- The ***maximum potential oil loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario.

- The ***average volume of oil ashore within a receptor*** – is determined by calculating the average volume of oil to come ashore within a receptor polygon, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.
- The ***maximum volume of oil ashore within a receptor*** – is determined by recording the maximum volume of oil to come ashore within a receptor polygon, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.
- The ***average length of shoreline contacted within a receptor*** – is determined by calculating the average of the length of shoreline (measured as grid cells) contacted by oil within a receptor polygon, at a specified threshold, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.
- The ***maximum length of shoreline contacted by oil*** – is determined by recording the maximum length of shoreline (measured as grid cells) contacted by oil within a receptor polygon, at a specified threshold, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.

8.2 Receptors Assessed

A range of environmental receptors and biological receptors and shorelines were assessed for sea surface exposure, shoreline contact and water column exposure as part of the study (see Table 12). The receptors are presented graphically in Figure 20 to Figure 34.

Note, the release location is situated within the Otway Integrated Marine and Coastal Regionalisation of Australia (IMCRA) receptor and hence this receptor will register all maximum values predicted by the modelling.

Table 12 Summary of receptors used to assess surface, shoreline and in-water exposure to hydrocarbons

Receptor Category	Acronym	Hydrocarbon Exposure Assessment		
		Water Column	Sea Surface	Shoreline
Marine National Park	MNP	✓	✓	✗
Australian Marine Park	AMP	✓	✓	✗
National Park	NP	✓	✓	✗
Integrated Marine and Coastal Regionalisation of Australia	IMCRA	✓	✓	✗
Interim Biogeographic Regionalisation of Australia	IBRA	✓	✓	✓
Key Ecological Feature	KEF	✓	✓	✗
Reefs, Shoals and Banks	RSB	✓	✓	✗
Ramsar	Ramsar	✓	✓	✓
State Waters	State Waters	✓	✓	✗
Local Government Areas	LGA	✓	✓	✓

Receptor Category	Acronym	Hydrocarbon Exposure Assessment		
		Water Column	Sea Surface	Shoreline
Sub-Local Government Areas	Sub-LGA	✓	✓	✓

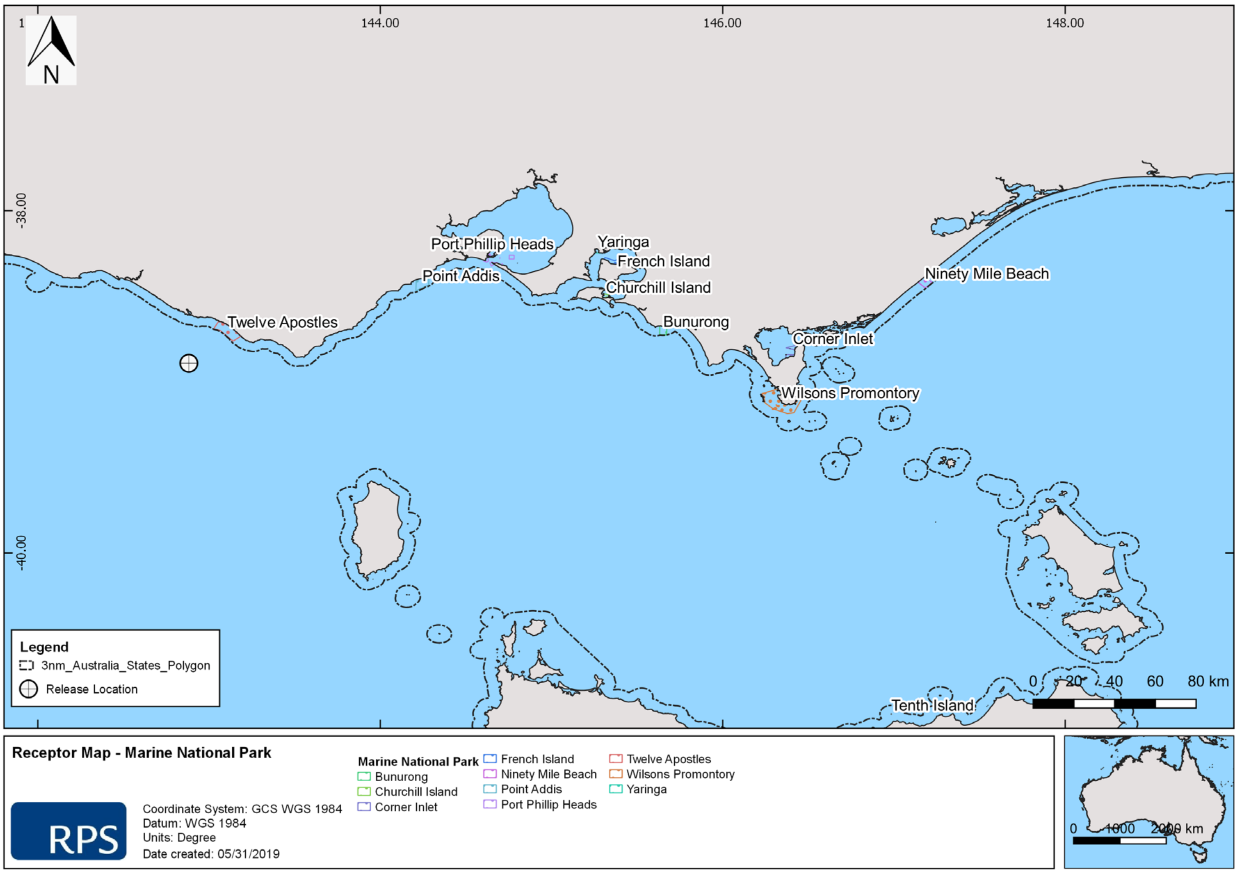

Figure 20 Receptor map for Marine National Parks.

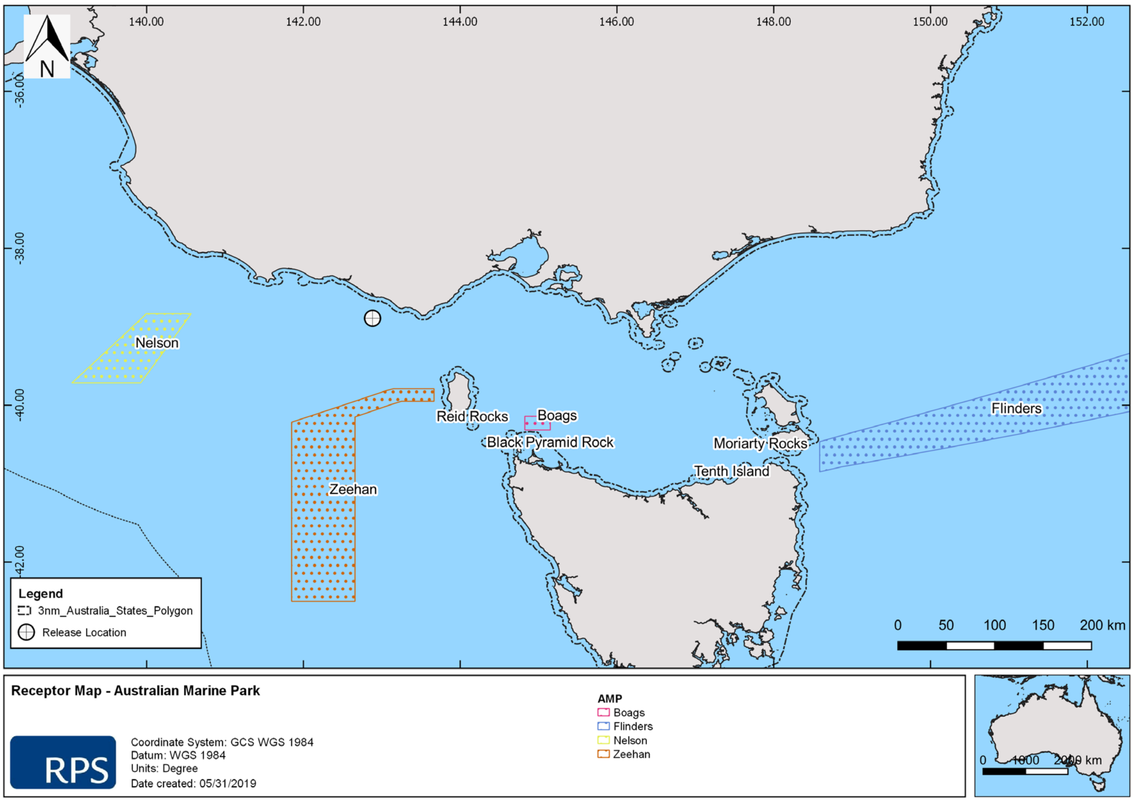

Figure 21 Receptor map for Australian Marine Parks.

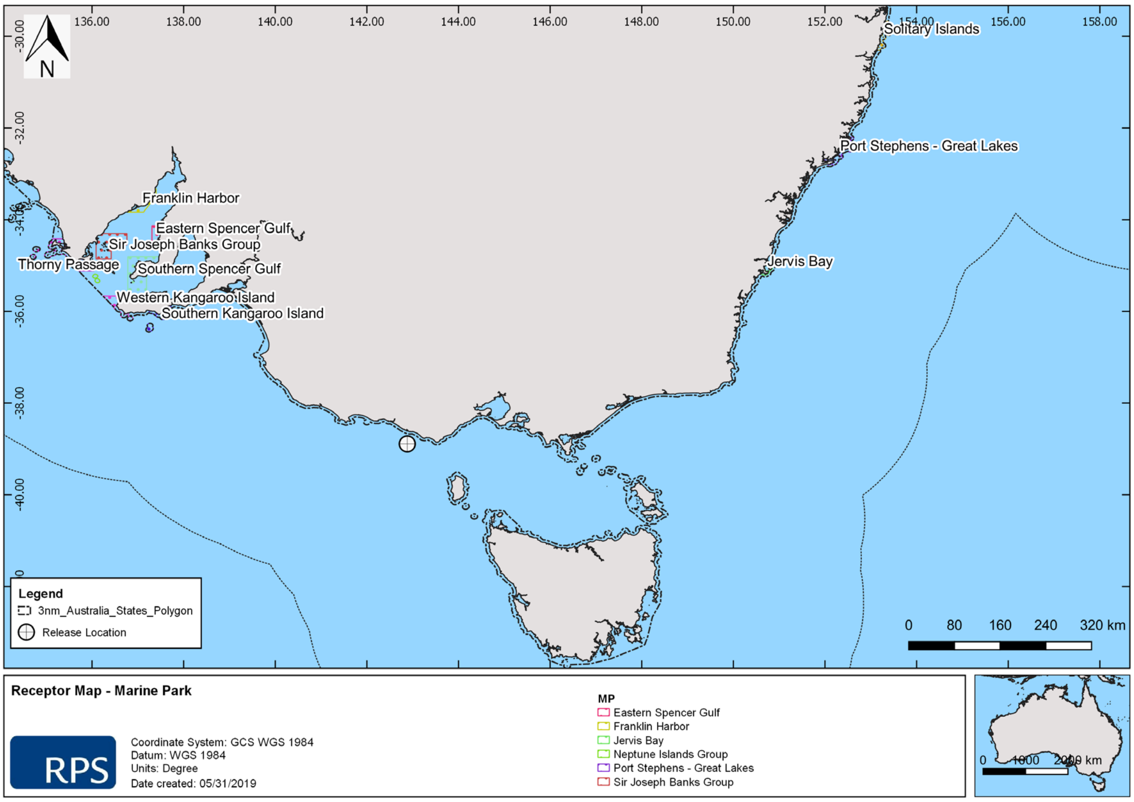

Figure 22 Receptor map for Marine Parks.

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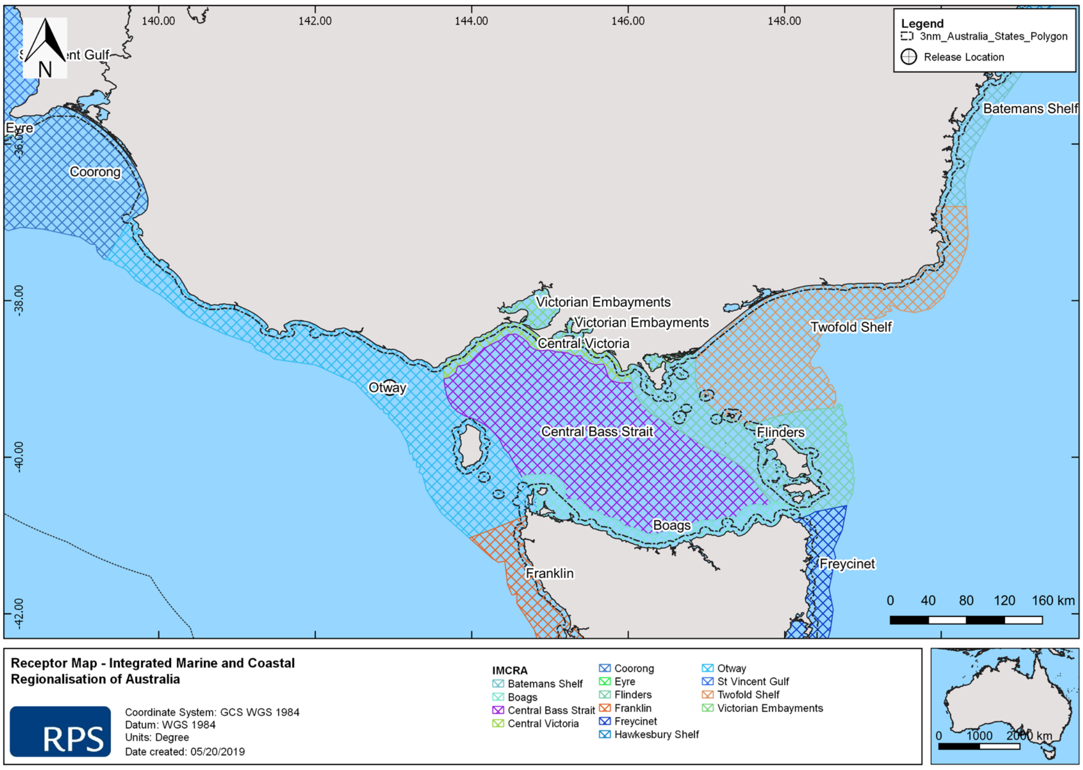

Figure 23 Receptor map illustrating the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) receptors.

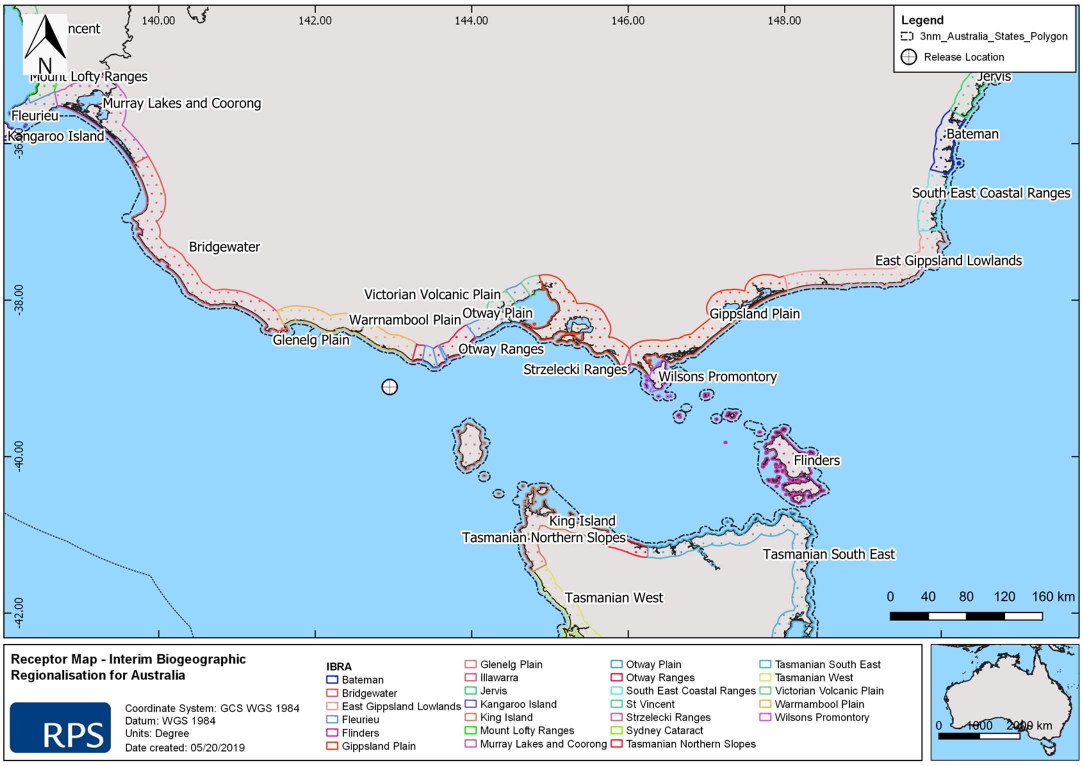

Figure 24 Map illustrating the Interim Biogeographic Regionalisation of Australia (IBRA) receptors.

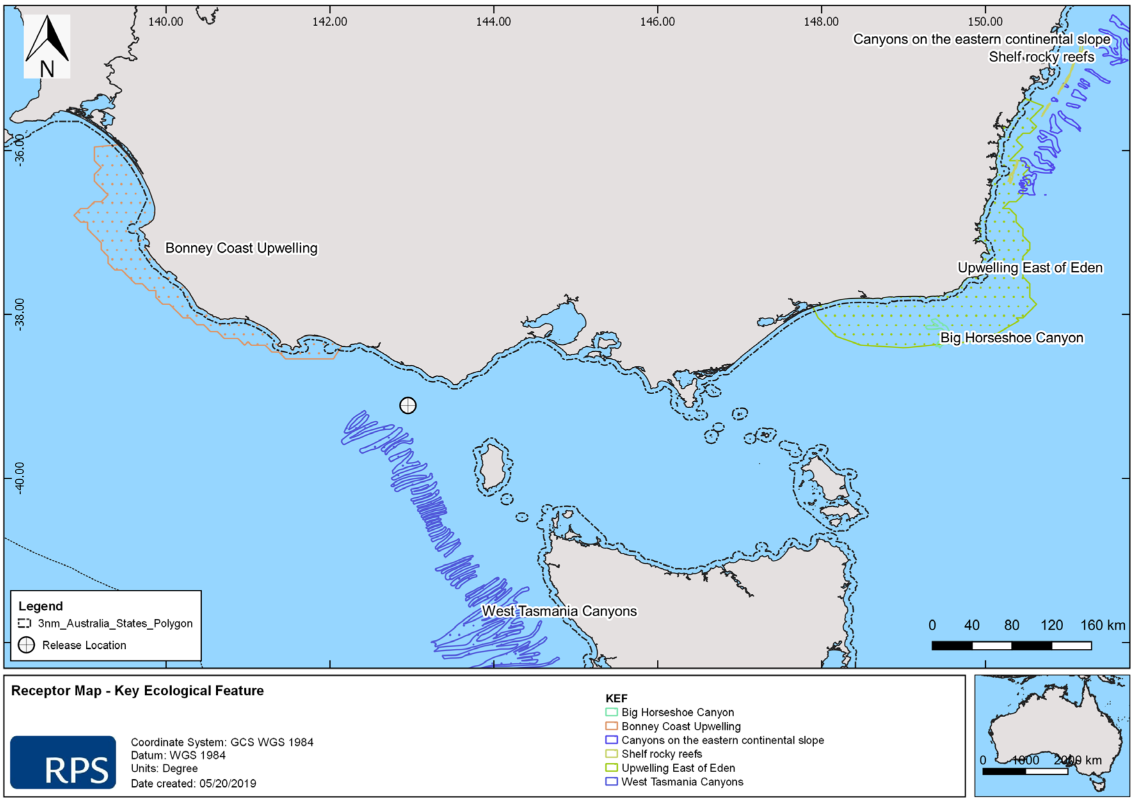

Figure 25 Receptor map of Key Ecological Features (KEF)

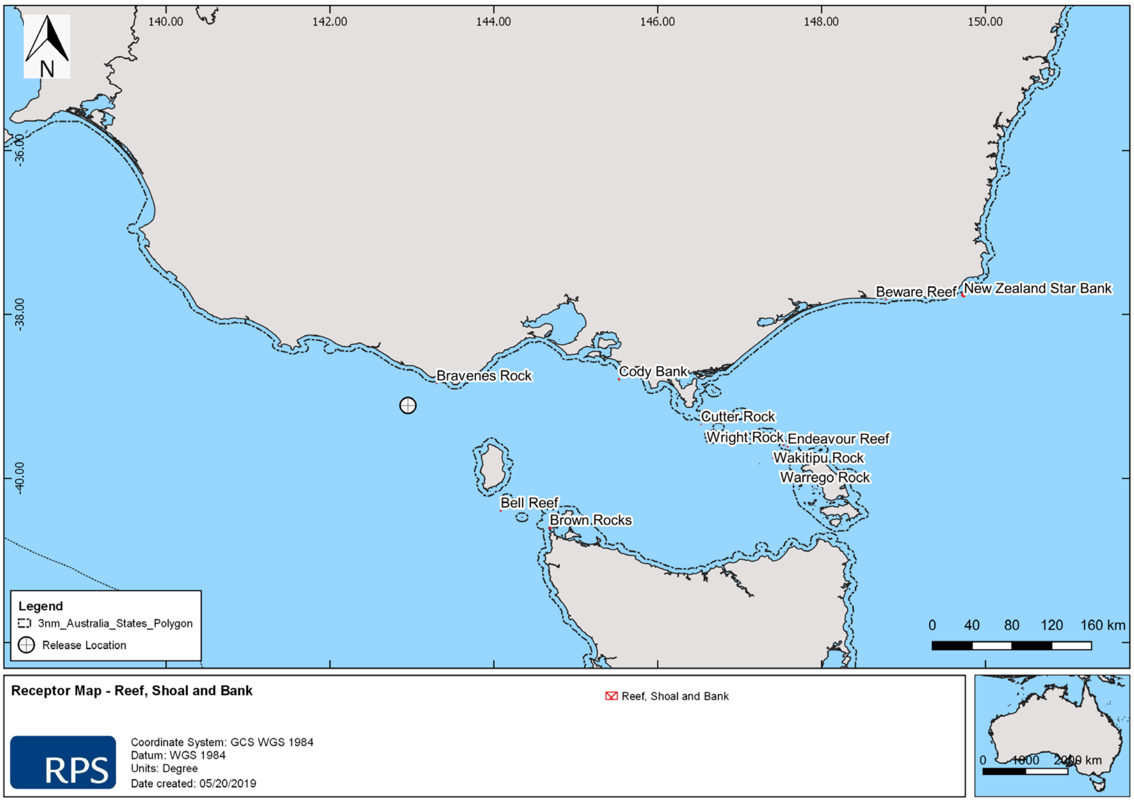

Figure 26 Receptor map of Reefs, Shoals and Banks (RSB)

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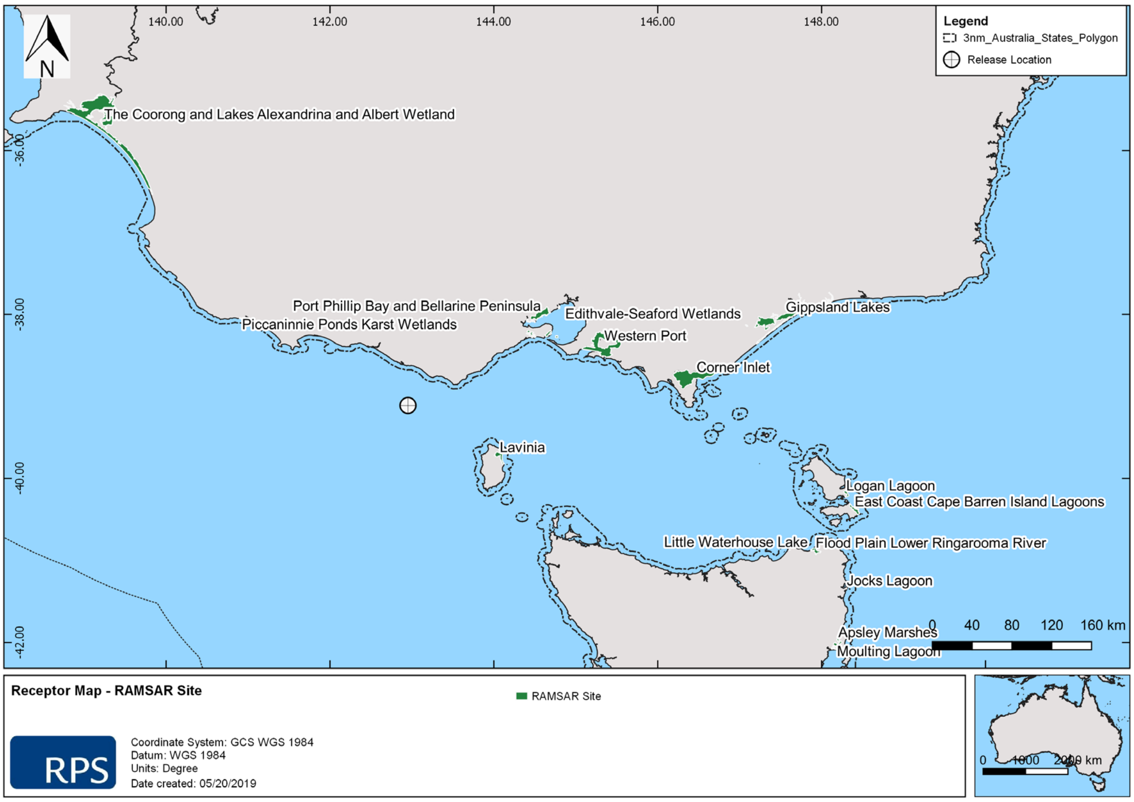

Figure 27 Receptor map of RAMSAR sites

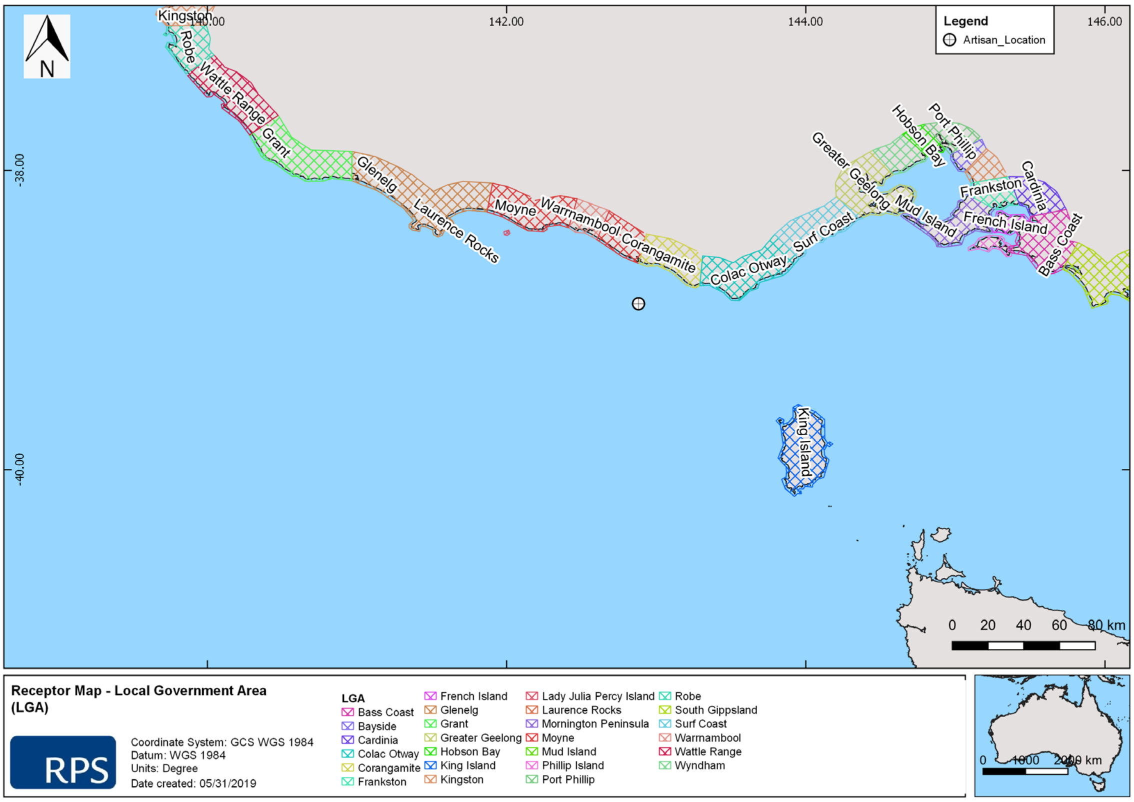

Figure 28 Receptor map of Local Government Areas (LGA) (1/3)

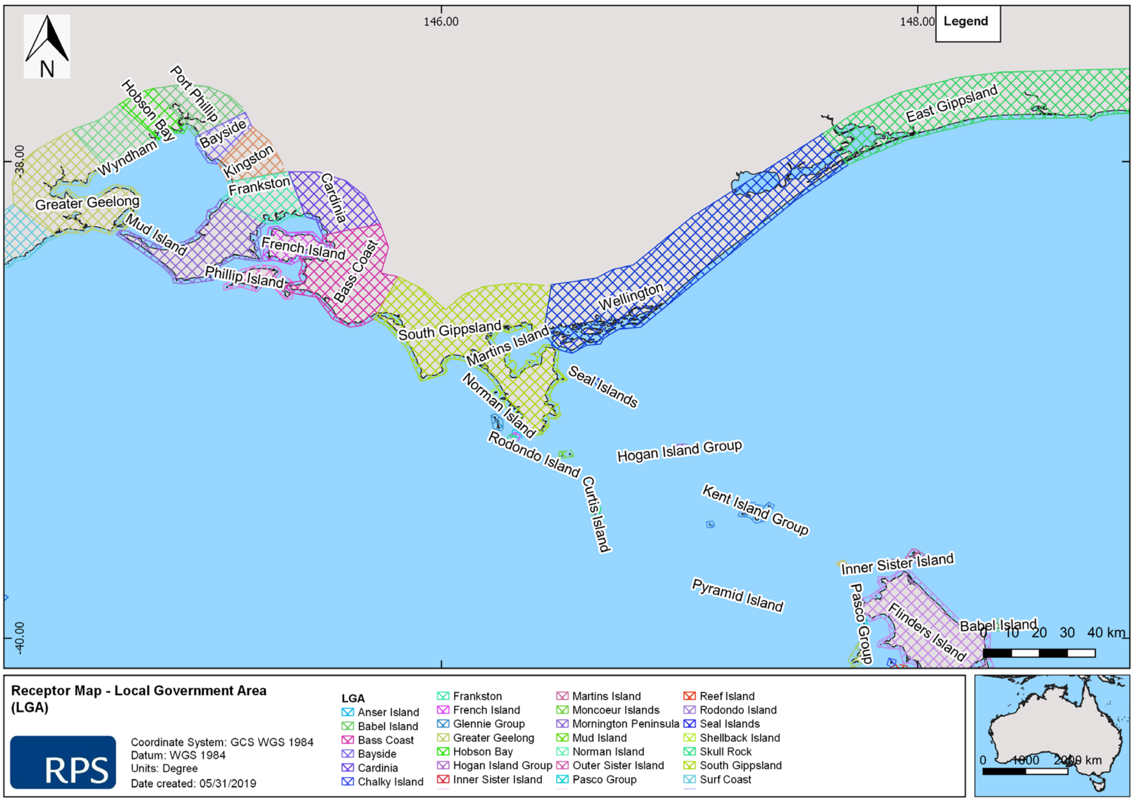

Figure 29 Receptor map of Local Government Areas (LGA) (2/3)

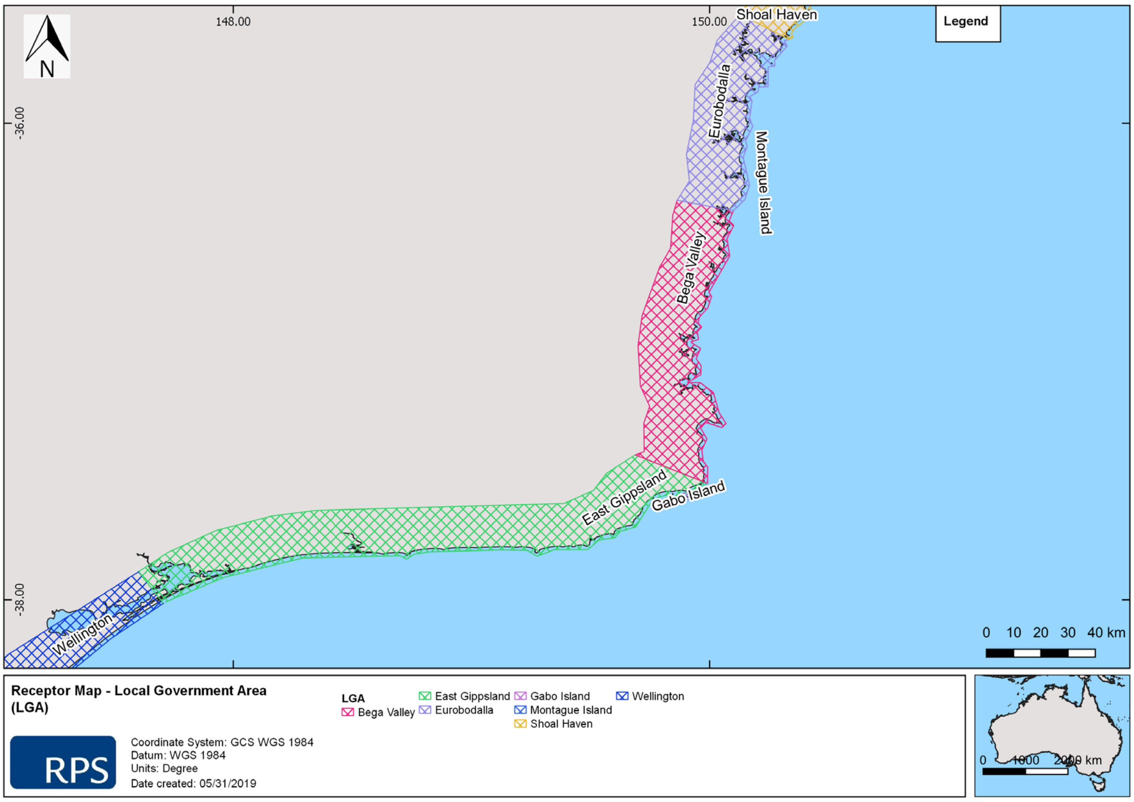

Figure 30 Receptor map of Local Government Areas (LGA) (3/3)

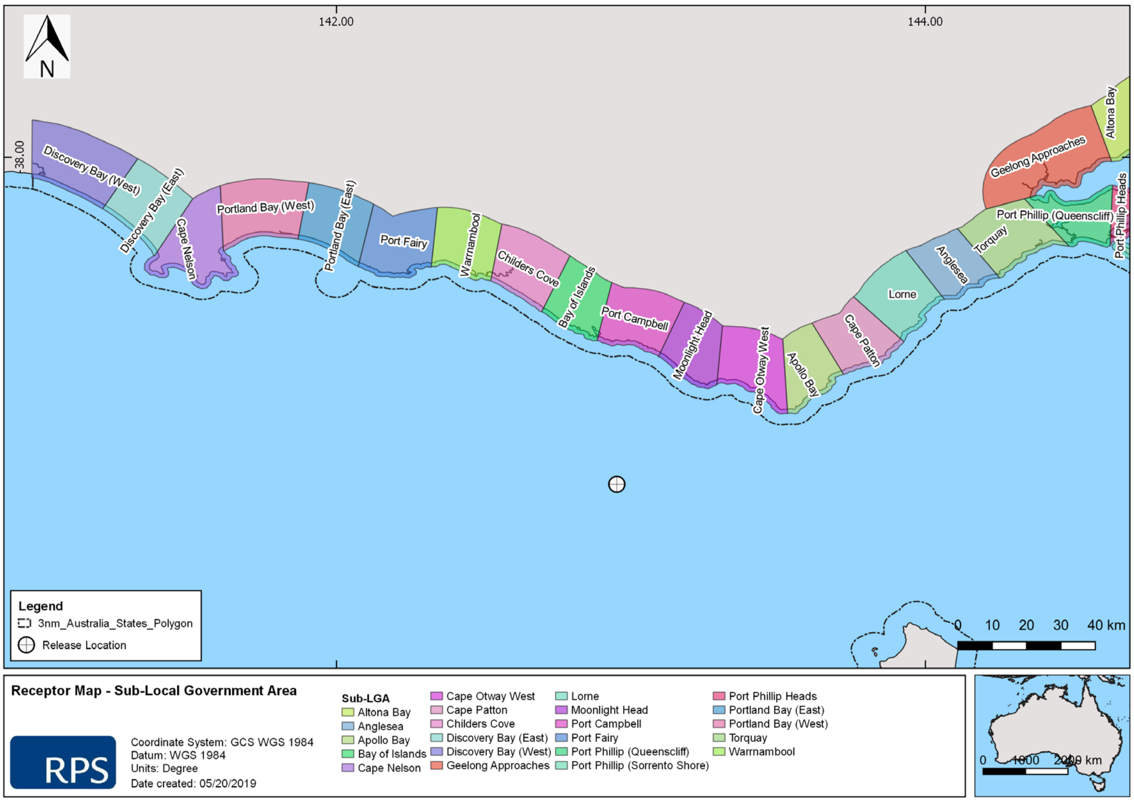

Figure 31 Receptor map of Sub-Local Government Areas (Sub-LGA) (1/3)

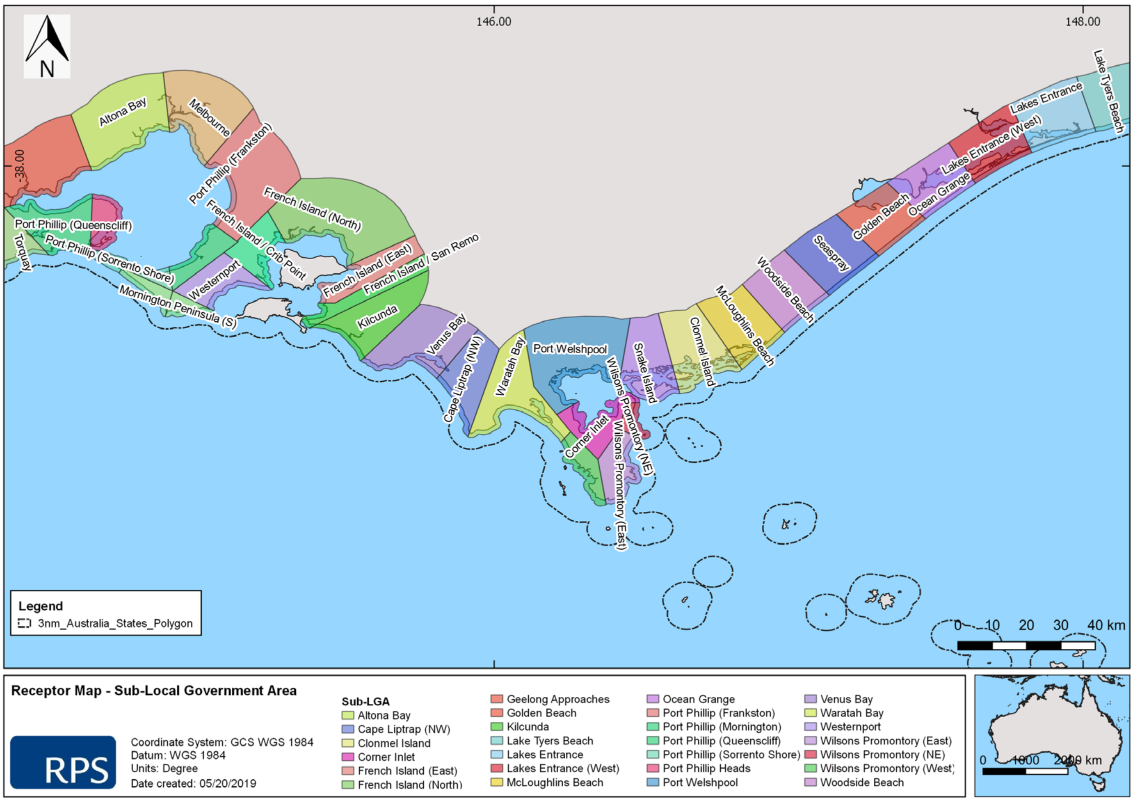

Figure 32 Receptor map of Sub-Local Government Areas (Sub-LGA) (2/3)

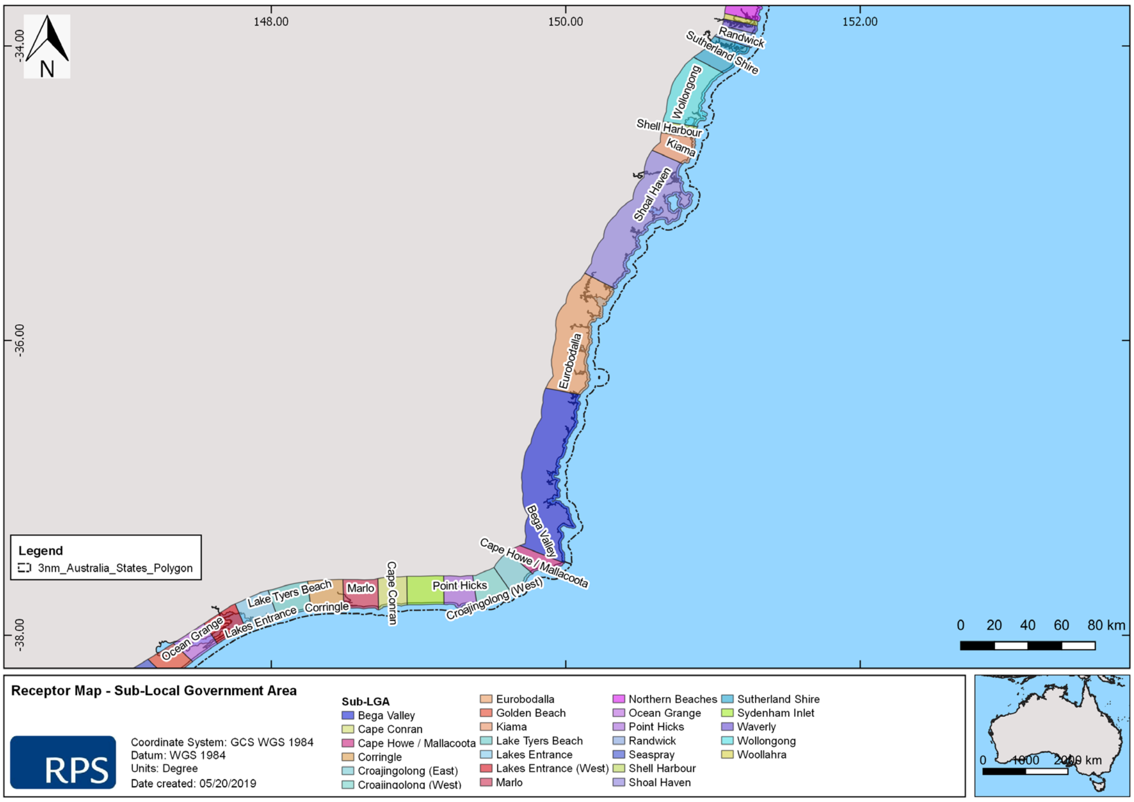

Figure 33 Receptor map of Sub-Local Government Areas (Sub-LGA) (3/3)

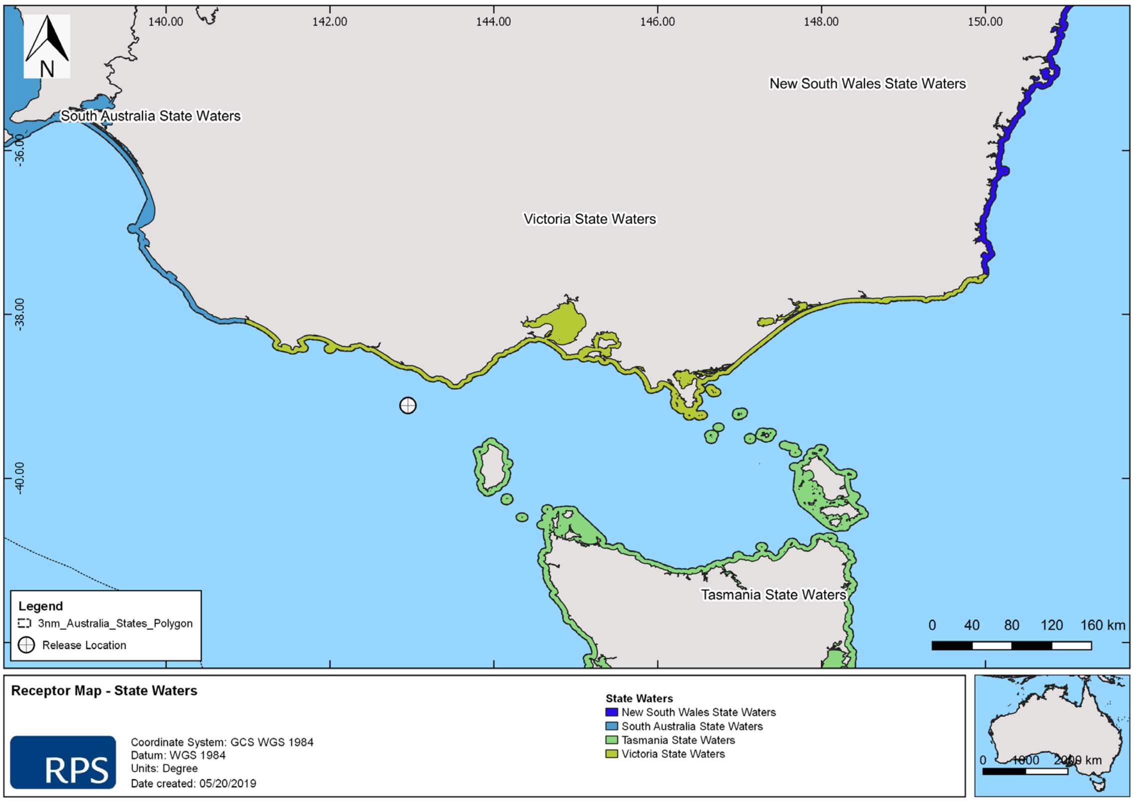

Figure 34 Receptor map of state waters.

RPS

9 RESULTS: 300 M^3 SURFACE RELEASE OF MARINE DIESEL OIL

The scenario examined a 300 m^3 release of MDO over 6 hours (tracked for 30 days) to represent a containment loss from a vessel at the Artisan-1 well location. A total of 100 spill trajectories were simulated for each of the seasons assessed, summer and winter.

Section 9.1 presents stochastic results in tabulated format.

Note, no shoreline contact was predicted for any of the seasons modelled above the minimum threshold.

9.1 Stochastic Analysis

9.1.1 Sea Surface Exposure

Table 13 presents a summary of the maximum distances and directions travelled by oil on the sea surface at the low (0.5-10 g/m^2), moderate (10-25 g/m^2) and high (>25 g/m^2) exposure thresholds for the two seasons. During summer conditions, low and moderate exposure was predicted up to 68 km and 12 km from the release location, respectively. Under winter conditions, low and moderate exposure was predicted up to 93 km and 10 km from the release location, respectively.

Table 14 presents the potential sea surface exposure to individual receptors predicted during summer and winter conditions. The modelling results demonstrated a 1% probability of oil exposure on the sea surface for the Central Victoria IMCRA receptor during the summer conditions. Stochastic results obtained during winter conditions exhibited a 1% probability of oil exposure on the sea surface for several receptors including the Central Victoria and Central Bass Strait IMCRA receptors, Apollo AMP and within Victorian State Waters.

None of the receptors were exposed at or above the moderate or high thresholds, with the exception of Otway IMCRA. Th Otway IMCRA receptor recorded low, moderate and high exposure due to the release location being situated within the boundaries of this receptor.

Table 13 Maximum distance and direction travelled on the sea surface by a single spill trajectory from the release location to the specified oil exposure thresholds.

Season	Distance and direction	Zones of potential sea surface exposure		
		Low	Moderate	High
Summer	Max. distance from release location (km)	68	12	6
	Max distance from release location (km) (99th percentile)	35	11	6
	Direction	E	NNE	E
Winter	Max. distance from release location (km)	93	10	6
	Max distance from release location (km) (99th percentile)	56	10	6
	Direction	E	WNW	ENE

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Table 14 Summary of the potential sea surface exposure to individual receptors

			Probability of oil exposure on the sea surface (%) for each threshold			Minimum time before oil exposure on the sea surface (hours) for each threshold		
Season	**Receptor**		**Low**	**Moderate**	**High**	**Low**	**Moderate**	**High**
Summer	IMCRA	Otway	100	98	48	1	1	1
		Central Victoria	1	-	-	89	-	-
Winter	IMCRA	Otway	100	98	41	1	1	1
		Central Victoria	1	-	-	133	-	-
		Central Bass Strait	1	-	-	71	-	-
	AMP	Apollo	1	-	-	35	-	-
	State Waters	Victoria State Waters	1	-	-	133	-	-

9.1.2 Water Column Exposure

9.1.2.1 Dissolved Hydrocarbons

Table 15 and Table 16 summarise the probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during summer and winter conditions.

The averaged dissolved hydrocarbon concentrations over 48 hours was highest within the Otway IMCRA receptor which registered 8 ppb and 9 ppb during summer and winter conditions, respectively. A 1% probability of exposure. No other receptors were exposed at or above the specified thresholds.

Based on the 1 hour exposure window, the Otway IMCRA receptor recorded the greatest dissolved hydrocarbon concentration of 76 ppb during summer and 59 ppb during winter. The Otway IMCRA receptor recorded a probability of 2% and 3% during the summer and winter conditions, respectively, based on the moderate threshold. There was no predicted exposure to other receptors at the moderate or high thresholds.

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Table 15 Predicted probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during summer conditions.

SUMMER Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48 hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of instantaneous dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
LGA	Colac Otway	1	-	-	-	6	1	-	-
SUB-LGA	Apollo Bay	1	-	-	-	6	1	-	-
IMCRA	Otway	8	1	-	-	76	47	2	-
	Central Victoria	1	-	-	-	21	2	-	-
	Central Bass Strait	1	-	-	-	20	1	-	-
IBRA	Otway Ranges	1	-	-	-	6	1	-	-
	Otway Plain	1	-	-	-	5	-	-	-
AMP	Apollo	1	-	-	-	22	3	-	-
State Waters	Victoria State Waters	1	-	-	-	17	2	-	-

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Table 16 Predicted probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during winter conditions.

WINTER Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure*			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of instantaneous dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderat e	High
LGA	Colac Otway	1	-	-	-	8	1	-	-
SUB-LGA	Cape Otway West	1	-	-	-	8	1	-	-
IMCRA	Otway	9	2	-	-	59	70	3	-
	Central Victoria	2	-	-	-	19	3	-	-
	Central Bass Strait	1	-	-	-	17	2	-	-
IBRA	Otway Ranges	1	-	-	-	5	-	-	-
	Otway Plain	1	-	-	-	8	1	-	-
AMP	Apollo	2	-	-	-	24	5	-	-
State Waters	Victoria State Waters	1	-	-	-	13	2	-	-

RPS

9.1.2.2 Entrained Hydrocarbons

Table 17 and Table 18 summarise the probability and maximum entrained hydrocarbon exposure for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during summer and winter conditions.

The maximum entrained hydrocarbon concentrations over 48 hour exposure window during summer and winter conditions was 2,182 ppb and 792 ppb, respectively. None of the receptors with the exception of the Otway IMCRA receptor were exposed at or above the moderate (100-1,000 ppb) or high (>1,000 ppb) thresholds during summer or winter conditions.

Based on the 1 hour exposure window, the maximum entrained hydrocarbon concentrations predicted for the Otway IMCRA receptor during summer and winter conditions was 5,933 ppb and 5,046 ppb, respectively. The probability of exposure at or above the moderate (100-1,000 ppb) threshold to receptors other than IMCRA Otway (83% summer and 93% winter) ranged from 1% (Cape Patton sub-LGA) to 8% (Victorian State Waters) during summer conditions and 1% (Twelve Apostles MNP) to 16% (Apollo AMP) during winter conditions. None of the receptors was exposed at or above the high threshold (1,000 ppb), with the exception of IMCRA – Otway.

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Table 17 Predicted probability and maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer during summer conditions.

SUMMER Receptor		Maximum time-entrained hydrocarbon exposure (ppb) for 48 hour window	Probability of entrained hydrocarbon exposure for 48 hour window			Maximum entrained hydrocarbon exposure (ppb) for 1 hour window	Probability of entrained hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	166	-	-	-	406	25	7	-
IBRA	Glenelg Plain	58	-	-	-	33	9	-	-
	Bridgewater	58	-	-	-	31	5	-	-
	Warrnambool Plain	317	-	-	-	228	25	4	-
	Otway Ranges	254	-	-	-	218	25	2	-
	Otway Plain	284	-	-	-	208	28	3	-
	Gippsland Plain	39	-	-	-	21	1	-	-
	Wilsons Promontory	21	-	-	-	12	1	-	-
IMCRA	Otway	2,182	1	-	-	5,933	97	83	39
	Victorian Embayments	14	-	-	-	11	1	-	-
	Central Victoria	178	-	-	-	399	22	5	-
	Central Bass Strait	172	-	-	-	334	13	2	-
	Flinders	22	-	-	-	13	1	-	-
KEF	Bonney Coast Upwelling	125	-	-	-	98	22	-	-
MNP	Discovery Bay	48	-	-	-	25	3	-	-
	Twelve Apostles	372	-	-	-	278	26	6	-
NP	Lower South East	24	-	-	-	22	2	-	-
	Bunurong Marine Park	24	-	-	-	14	1	-	-
	Wilsons Promontory Marine Park	21	-	-	-	12	1	-	-
LGA	Phillip Island	20	-	-	-	19	1	-	-
	Norman Island	21	-	-	-	12	1	-	-

	Shellback Island	20	-	-	-	11	1	-	-
	Glenelg	58	-	-	-	33	9	-	-
	Warrnambool	46	-	-	-	24	8	-	-
	Moyne	172	-	-	-	96	17	-	-
	Corangamite	317	-	-	-	218	26	4	-
	Colac Otway	284	-	-	-	208	28	3	-
	Surf Coast	69	-	-	-	48	5	-	-
	Mornington Peninsula	19	-	-	-	11	1	-	-
	Bass Coast	40	-	-	-	21	1	-	-
	South Gippsland	22	-	-	-	12	1	-	-
	Grant	26	-	-	-	20	1	-	-
	Lady Julia Percy Island	73	-	-	-	43	5	-	-
	Laurence Rocks	41	-	-	-	26	7	-	-
State Waters	South Australia State Waters	31	-	-	-	26	2	-	-
	Victoria State Waters	372	-	-	-	388	30	8	-
SUB-LGA	Wilsons Promontory (West)	22	-	-	-	12	1	-	-
	Venus Bay	21	-	-	-	13	1	-	-
	Kilcunda	40	-	-	-	21	1	-	-
	French Island / San Remo	14	-	-	-	10	1	-	-
	Mornington Peninsula (SW)	18	-	-	-	10	1	-	-
	Port Phillip (Sorrento Shore)	18	-	-	-	11	1	-	-
	Anglesea	21	-	-	-	13	3	-	-
	Lorne	78	-	-	-	49	5	-	-
	Cape Patton	156	-	-	-	132	14	1	-
	Apollo Bay	168	-	-	-	208	21	3	-
	Cape Otway West	284	-	-	-	197	28	2	-
	Moonlight Head	317	-	-	-	218	26	4	-
	Port Campbell	220	-	-	-	157	18	2	-

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Bay of Islands	172	-	-	-	96	17	-	-
Childers Cove	62	-	-	-	43	10	-	-
Warrnambool	27	-	-	-	23	7	-	-
Port Fairy	56	-	-	-	36	2	-	-
Portland Bay (East)	31	-	-	-	21	2	-	-
Portland Bay (West)	38	-	-	-	21	1	-	-
Cape Nelson	58	-	-	-	31	9	-	-
Discovery Bay (East)	46	-	-	-	24	2	-	-
Discovery Bay (West)	24	-	-	-	16	2	-	-

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Table 18 Predicted probability and maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer during winter conditions.

WINTER Receptor		Maximum time-entrained hydrocarbon exposure (ppb) for 48 hour window	Probability of entrained hydrocarbon exposure for 48 hour window			Maximum entrained hydrocarbon exposure (ppb) for 1 hour window	Probability of entrained hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	99	-	-	-	501	54	16	-
	Beagle	6	-	-	-	11	2	-	-
IBRA	Flinders	5	-	-	-	10	1	-	-
	Warrnambool Plain	54	-	-	-	98	17	-	-
	Otway Ranges	169	-	-	-	196	21	4	-
	Otway Plain	298	-	-	-	448	27	6	-
	Gippsland Plain	20	-	-	-	23	8	-	-
	Strzelecki Ranges	12	-	-	-	13	1	-	-
	Wilsons Promontory	19	-	-	-	21	3	-	-
IMCRA	Twofold Shelf	5	-	-	-	10	1	-	-
	Otway	792	2	-	-	5,046	99	93	58
	Victorian Embayments	18	-	-	-	20	3	-	-
	Central Victoria	137	-	-	-	446	54	14	-
	Central Bass Strait	69	-	-	-	386	51	13	-
	Flinders	19	-	-	-	22	4	-	-
KEF	West Tasmania Canyons	12	-	-	-	14	1	-	-
	Bonney Coast Upwelling	13	-	-	-	15	1	-	-
MNP	Bunurong	10	-	-	-	12	1	-	-
	Point Addis	16	-	-	-	17	2	-	-
	Port Phillip Heads	15	-	-	-	19	4	-	-

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	Twelve Apostles	129	-	-	-	283	15	1	-
	Wilsons Promontory	14	-	-	-	16	3	-	-
NP	Wilsons Promontory Marine Park	17	-	-	-	20	2	-	-
RAMSAR	Port Phillip Bay and Bellarine Peninsula	7	-	-	-	10	1	-	-
LGA	Phillip Island	19	-	-	-	22	3	-	-
	Hogan Island Group	5	-	-	-	10	1	-	-
	Glennie Group	14	-	-	-	15	3	-	-
	Norman Island	19	-	-	-	20	3	-	-
	Shellback Island	17	-	-	-	21	2	-	-
	Anser Island	11	-	-	-	12	2	-	-
	Kanowna Island	10	-	-	-	12	2	-	-
	Skull Rock	10	-	-	-	12	2	-	-
	Warrnambool	8	-	-	-	10	1	-	-
	Moyne	49	-	-	-	71	6	-	-
	Corangamite	44	-	-	-	98	18	-	-
	Colac Otway	298	-	-	-	448	27	6	-
	Surf Coast	21	-	-	-	23	3	-	-
	Greater Geelong	20	-	-	-	22	3	-	-
	Mornington Peninsula	20	-	-	-	23	8	-	-
	South Gippsland	18	-	-	-	21	2	-	-
	Lady Julia Percy Island	8	-	-	-	11	1	-	-
State Waters	Tasmania State Waters	6	-	-	-	11	2	-	-
	Victoria State Waters	298	-	-	-	548	40	9	-
SUB-LGA	Wilsons Promontory (West)	18	-	-	-	21	2	-	-
	Waratah Bay	12	-	-	-	13	1	-	-
	Cape Liptrap (NW)	13	-	-	-	15	1	-	-

Westernport	11	-	-	-	14	2	-	-
Mornington Peninsula (S)	14	-	-	-	16	8	-	-
Mornington Peninsula (SW)	20	-	-	-	23	8	-	-
Port Phillip (Sorrento Shore)	20	-	-	-	22	4	-	-
Port Phillip Heads	10	-	-	-	13	3	-	-
Port Phillip (Queenscliff)	11	-	-	-	15	3	-	-
Torquay	20	-	-	-	22	2	-	-
Anglesea	12	-	-	-	14	2	-	-
Lorne	16	-	-	-	18	3	-	-
Cape Patton	68	-	-	-	95	7	-	-
Apollo Bay	70	-	-	-	84	27	-	-
Cape Otway West	298	-	-	-	448	27	6	-
Moonlight Head	44	-	-	-	98	18	-	-
Port Campbell	43	-	-	-	65	7	-	-
Bay of Islands	49	-	-	-	71	6	-	-
Childers Cove	31	-	-	-	41	1	-	-

*Concentration recorded over a 48-hour window.
^Instantaneous concentration recorded over one hour.

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10 RESULTS: 222,224 BBL SUBSEA RELEASE OF CONDENSATE

The scenario examined a 222,224 bbl subsea release of Thylacine condensate over 86 days (tracked for 114 days) to represent an unrestricted open-hole loss of well control from Artisan-1 well location. A total of 100 spill trajectories were simulated for each of the seasons assessed, summer and winter.

Section 10.1 presents stochastic results for sea surface, shoreline and in-water exposure in tabulated format.

10.1 Stochastic Analysis

10.1.1 Sea Surface Exposure and Shoreline Contact

Table 19 presents a summary of the maximum distance and direction travelled by condensate on the sea surface at the low (0.5-10 g/m^2), moderate (10-25 g/m^2) and high (>25 g/m^2) exposure thresholds for each of the two seasons considered, summer and winter. During summer conditions, low and moderate exposure of surface hydrocarbons were predicted up to 52 km and 4 km from the release location, respectively, while during winter, low and moderate exposure surface hydrocarbons extended to a maximum distance of 53 km and 3 km from the release location, respectively. Note, no high exposure from surface hydrocarbons was predicted for any of the seasons assessed.

Table 20 presents the potential sea surface exposure to individual receptors predicted during summer and winter conditions. The probability of hydrocarbon exposure on the sea surface at or above the low threshold was predicted to range from 6% (Otway Ranges IBRA) to 16% (Colac Otway LGA, Cape Otway West sub-LGA and Victorian State Waters) during summer conditions, with the exception of Otway IMCRA receptor (100%). The winter stochastic modelling results demonstrated a larger number of receptors potentially exposed to surface hydrocarbons at or above low levels with a probability of exposure predicted to range from 3% (Twelve Apostles MNP and Otway Ranges IBRA) to 40% (Otway Plain IBRA, Cape Otway West sub-LGA and Colac Otway LGA), with the exception of Otway IMCRA (100%) and within Victorian State Waters (57%). None of the receptors other than the Otway IMCRA were exposed at or above the moderate or high thresholds for any seasons assessed.

Table 21 presents a summary of potential hydrocarbon contact to any shorelines for summer and winter conditions while Table 22 summarises potential shoreline contact to individual receptors, for each season.

The probability of contact to any shoreline was 16% and 57% for the summer and winter season, respectively, while the minimum time for visible surface hydrocarbon to reach a shoreline was 3 days for 5 days, respectively. The maximum volume of hydrocarbons predicted to come ashore was 15 m^3 and 33 m^3, during summer and winter conditions, respectively, while the maximum length of shoreline contacted above the low threshold (>10 g/m^2) was 7.0 km and 11.0 km, respectively. Note, no shoreline loading above 1,000 g/m^2 was predicted.

The Otway IMCRA shoreline was the only receptor to record of contact above 100 g/m^2 with a probability of 3% during summer and 2% during winter conditions. The modelling results during winter conditions demonstrated additional shoreline contact to Moyne, Corangamite, Moonlight head and Childers Cove.

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Table 19 Maximum distance and direction travelled on the sea surface by a single spill trajectory from the release location to the specified oil exposure thresholds.

Season	Distance and direction	Zones of potential sea surface exposure		
		Low	Moderate	High
Summer	Max. distance from release site (km)	52	4	NA
	Max distance from release site (km) (99th percentile)	34	4	NA
	Direction	E	E	NA
Winter	Max. distance from release site (km)	53	3	NA
	Max distance from release site (km) (99th percentile)	49	3	NA
	Direction	NNW	W	NA

Table 20 Summary of the potential sea surface exposure to individual receptors

			Probability of oil exposure on the sea surface (%)			Minimum time before oil exposure on the sea surface (hours)		
Season	Receptor		Low	Moderate	High	Low	Moderate	High
Summer	LGA	Colac Otway	16	-	-	80	-	-
	SUB-LGA	Cape Otway West	16	-	-	80	-	-
	IMCRA	Otway	100	100	-	1	3	-
	IBRA	Otway Ranges	6	-	-	1,343	-	-
		Otway Plain	12	-	-	80	-	-
	State Waters	Victoria State Waters	16	-	-	80	-	-
Winter	LGA	Moyne	8	-	-	649	-	-
		Corangamite	14	-	-	311	-	-
		Colac Otway	40	-	-	188	-	-
	SUB-LGA	Cape Otway West	40	-	-	188	-	-
		Moonlight Head	14	-	-	311	-	-
		Childers Cove	8	-	-	649	-	-
	IMCRA	Otway	100	100	-	1	2	-
	IBRA	Warrnambool Plain	22	-	-	311	-	-
		Otway Ranges	3	-	-	413	-	-
		Otway Plain	40	-	-	188	-	-
	MNP	Twelve Apostles	3	-	-	821	-	-
	State Waters	Victoria State Waters	57	-	-	188	-	-

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Table 21 Summary of potential oil contact to any shoreline for each season assessed

Shoreline statistics	Summer	Winter
Probability of contact to any shoreline (%)	16	57
Minimum time for visible oil to reach a shoreline (days)	3	5
Maximum volume of hydrocarbons ashore (m^3)	15	33
Average volume of hydrocarbons ashore (m^3)	1	5
Maximum length of the shoreline >10 g/m^2 (km)	7.0	11.0
Average shoreline length (km) >10 g/m^2 (km)	4.7	5.6
Maximum length of the shoreline >100 g/m^2 (km)	4.0	8.0
Average shoreline length (km) >100 g/m^2 (km)	2.4	3.5
Maximum length of the shoreline >1,000 g/m^2 (km)	-	-
Average shoreline length (km) > 1,000 g/m^2 (km)	-	-

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Table 22 Summary of the potential shoreline contact to individual receptors for each season assessed

		Probability of shoreline loading (%)			Minimum time before shoreline accumulation (hours)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline contacted (km)			Maximum length of shoreline contacted (km)		
Season	**Receptor**	**>10 g/m²**	**>100 g/m²**	**>1,000 g/m²**	**>10 g/m²**	**>100 g/m²**	**>1,000 g/m²**	**Mean**	**Peak**	**Mean**	**Peak**	**>10 g/m²**	**>100 g/m²**	**>1,000 g/m²**	**>10 g/m²**	**>100 g/m²**	**>1,000 g/m²**
Summer	Colac Otway	16	15	-	77	277	-	136	520	1	15	5	2	-	7	4	-
	Cape Otway West	16	15	-	77	277	-	136	520	1	15	5	2	-	7	4	-
Winter	Moyne	8	8	-	26	27	-	88	130	<1	5	4	2	-	5	2	-
	Corangamite	14	10	-	635	654	-	241	984	2	23	4	3	-	5	3	-
	Colac Otway	40	40	-	125	247	-	194	670	5	33	6	4	-	11	8	-
	Cape Otway West	40	40	-	109	174	-	194	670	5	33	6	4	-	11	8	-
	Moonlight Head	14	10	-	109	174	-	241	984	2	23	4	3	-	5	3	-
	Childers Cove	8	8	-	125	247	-	88	130	<1	5	4	2	-	5	2	-

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10.1.2 Water Column Exposure

10.1.2.1 Dissolved Hydrocarbons

Table 23 and Table 24 summarise the probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during summer and winter conditions.

For the 48 hour time-averaged exposure window, dissolved hydrocarbons remained below 30 ppb in summer and 34 ppb in winter conditions, and hence no moderate or high exposure was predicted under the seasonal conditions modelled. During summer conditions, the probability of low exposure ranged from 1% (Bonney Coast Upwelling KEF, Moyne LGA, Bay of Islands and Childers Cove sub-LGAs) to 17% (Otway Plain IBRA, Colac Otway LGA, Cape Otway West sub-LGA and within Victoria State Waters)The Otway IMCRA recorded a probability of 50% during summer. During winter conditions, the probability of low exposure to dissolved hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF, Bay of Islands and Lorne sub-LGA) to 16% (within Victoria State Waters). The Otway IMCRA registered a probability of 42% for winter. None of the receptors were exposed to moderate (50 – 400 ppb) or high (>400 ppb) dissolved hydrocarbons (over a 48 hour basis) during the summer or winter season.

The analysis for the dissolved hydrocarbons over a 1 hour window showed that the maximum exposure was 309 ppb during summer and 289 ppb during winter, which was predicted within the Otway IMCRA and Victorian State Waters. During summer conditions, the probability of moderate exposure to dissolved hydrocarbons ranged from 1% (Glenelg Plain and Bridgewater IBRA's; Glenelg, Moyne and Surf Coast LGAs; Lorne, Bay of Islands, Childers Cove and Cape Nelson sub-LGAs) to 43% (Otway Plain IBRA, Colac Otway LGA, Cape Otway West sub-LGA and within Victoria State Waters). The probability for Otway IMCRA was 58%. Under winter conditions, the probability of moderate exposure (over 1 hour) to dissolved hydrocarbons ranged from 1% (Gippsland Plain IBRA; Flinders IMCRA; Point Addis and Wilsons Promontory MNP; Mornington Peninsula LGA; Lorne, Mornington Peninsula and Childers Cove sub-LGAs) to 57% for the Victorian State Waters. The probability of exposure to the Otway IMCRA was 68%. None of the receptors were exposed high concentrations during the summer or winter season.

Table 23 Predicted probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during summer conditions.

SUMMER Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48 hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of instantaneous dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	20	11	-	-	225	98	30	-
	Beagle	1	-	-	-	9	1	-	-
	Nelson	1	-	-	-	18	3	-	-
	Zeehan	1	-	-	-	19	4	-	-
IBRA	Glenelg Plain	6	-	-	-	53	25	1	-
	Bridgewater	4	-	-	-	54	20	1	-
	Warrnambool Plain	24	5	-	-	217	99	14	-
	Otway Ranges	13	7	-	-	161	100	27	-
	Otway Plain	23	17	-	-	235	98	43	-
	Gippsland Plain	3	-	-	-	28	11	-	-
	Wilsons Promontory	1	-	-	-	12	3	-	-
IMCRA	Coorong	0	-	-	-	12	1	-	-
	Otway	30	50	-	-	309	100	58	-
	Victorian Embayment	3	-	-	-	31	6	-	-
	Central Victoria	18	9	-	-	253	95	28	-
	Central Bass Strait	17	6	-	-	254	88	20	-
	Flinders	2	-	-	-	26	5	-	-
KEF	West Tasmania Canyons	2	-	-	-	34	8	-	-
	Bonney Coast Upwelling	10	1	-	-	97	60	2	-
MNP	Churchill Island	1	-	-	-	7	2	-	-
	Discovery Bay	3	-	-	-	41	15	-	-
	Point Addis	2	-	-	-	34	14	-	-
	Port Phillip Heads	2	-	-	-	21	7	-	-
	Twelve Apostles	27	6	-	-	217	98	20	-
	Wilsons Promontory	2	-	-	-	12	2	-	-

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MP	Lower South East	1	-	-	-	16	3	-	-
	Bunurong Marine Park	1	-	-	-	10	3	-	-
NP	Wilsons Promontory Marine Park	1	-	-	-	6	1	-	-
	Port Phillip Bay and Bellarine Peninsula	1	-	-	-	31	4	-	-
RAMSAR	Western Port	1	-	-	-	12	2	-	-
SHORE	Phillip Island	2	-	-	-	24	11	-	-
	Mud Island	1	-	-	-	12	2	-	-
	Moncoeur Islands	1	-	-	-	9	1	-	-
	Rodondo Island	1	-	-	-	11	2	-	-
	Glennie Group	1	-	-	-	12	3	-	-
	Norman Island	1	-	-	-	10	1	-	-
	Anser Island	1	-	-	-	6	1	-	-
	Kanowna Island	1	-	-	-	10	1	-	-
	Skull Rock	1	-	-	-	7	1	-	-
	Glenelg	6	-	-	-	54	25	1	-
	Warrnambool	5	-	-	-	46	25	-	-
	Moyne	7	1	-	-	66	74	1	-
	Corangamite	24	5	-	-	217	100	17	-
	Colac Otway	23	17	-	-	235	100	43	-
	Surf Coast	5	-	-	-	57	24	1	-
	Greater Geelong	2	-	-	-	31	8	-	-
	Mornington Peninsula	3	-	-	-	28	11	-	-
	Bass Coast	1	-	-	-	21	5	-	-
	South Gippsland	1	-	-	-	7	1	-	-
	Grant	1	-	-	-	19	3	-	-
	Lady Julia Percy Island	2	-	-	-	28	22	-	-
	Laurence Rocks	5	-	-	-	18	20	-	-
State Waters	South Australia State Waters	1	-	-	-	26	6	-	-
	Victoria State Waters	30	17	-	-	309	100	43	-
SUB-LGA	Wilsons Promontory (West)	1	-	-	-	6	1	-	-
	Cape Liptrap (NW)	1	-	-	-	7	1	-	-
	Venus Bay	1	-	-	-	10	3	-	-

Kilcunda	1	-	-	-	21	5	-	-
French Island / San Remo	1	-	-	-	14	4	-	-
French Island / Crib Point	1	-	-	-	6	1	-	-
Westernport	1	-	-	-	13	6	-	-
Mornington Peninsula (S)	1	-	-	-	14	7	-	-
Mornington Peninsula (SW)	2	-	-	-	24	11	-	-
Port Phillip (Sorrento Shore)	3	-	-	-	23	8	-	-
Port Phillip Heads	1	-	-	-	31	6	-	-
Port Phillip (Queenscliff)	2	-	-	-	23	7	-	-
Torquay	3	-	-	-	23	8	-	-
Anglesea	3	-	-	-	32	12	-	-
Lorne	5	-	-	-	57	24	1	-
Cape Patton	11	2	-	-	161	85	8	-
Apollo Bay	13	4	-	-	154	95	15	-
Cape Otway West	23	17	-	-	235	100	43	-
Moonlight Head	24	5	-	-	217	100	17	-
Port Campbell	12	3	-	-	103	77	6	-
Bay of Islands	7	1	-	-	66	74	1	-
Childers Cove	7	1	-	-	55	55	1	-
Warrnambool	3	-	-	-	36	16	-	-
Port Fairy	2	-	-	-	23	11	-	-
Portland Bay (East)	1	-	-	-	10	2	-	-
Cape Nelson	6	-	-	-	54	25	1	-
Discovery Bay (East)	1	-	-	-	11	2	-	-
Discovery Bay (West)	1	-	-	-	8	1	-	-

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Table 24 Predicted probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during winter conditions .

WINTER Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48 hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of instantaneous dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	13	7	-	-	237	100	39	-
	Beagle	2	-	-	-	37	13	-	-
	Zeehan	1	-	-	-	16	3	-	-
IBRA	King Island	1	-	-	-	9	1	-	-
	Flinders	1	-	-	-	9	2	-	-
	Glenelg Plain	4	-	-	-	19	2	-	-
	Bridgewater	2	-	-	-	8	1	-	-
	Warrnambool Plain	14	4	-	-	237	100	21	-
	Otway Ranges	14	6	-	-	248	100	35	-
	Otway Plain	30	10	-	-	203	100	51	-
	Gippsland Plain	6	-	-	-	51	16	1	-
	Strzelecki Ranges	4	-	-	-	31	18	-	-
	Wilsons Promontory	4	-	-	-	34	21	-	-
IMCRA	Twofold Shelf	2	-	-	-	28	6	-	-
	Otway	34	42	-	-	289	100	68	-
	Victorian Embayments	4	-	-	-	36	9	-	-
	Central Victoria	25	7	-	-	235	100	33	-
	Central Bass Strait	17	4	-	-	282	100	26	-
	Flinders	5	-	-	-	66	27	1	-
KEF	West Tasmania Canyons	4	-	-	-	36	8	-	-
	Bonney Coast Upwelling	6	1	-	-	86	19	2	-
	Upwelling East of Eden	1	-	-	-	9	1	-	-
MNP	Bunurong	2	-	-	-	34	10	-	-
	Churchill Island	1	-	-	-	8	1	-	-
	Point Addis	5	-	-	-	51	41	1	-

	Port Phillip Heads	1	-	-	-	15	8	-	-
	Twelve Apostles	16	6	-	-	155	100	18	-
	Wilsons Promontory	5	-	-	-	66	23	1	-
NP	Bunurong Marine Park	1	-	-	-	24	8	-	-
	Wilsons Promontory Marine Park	4	-	-	-	33	9	-	-
RAMSAR	Port Phillip Bay and Bellarine Peninsula	1	-	-	-	14	2	-	-
	Western Port	3	-	-	-	22	2	-	-
SHORE	King Island	1	-	-	-	9	1	-	-
	Seal Islands	2	-	-	-	15	2	-	-
	Phillip Island	3	-	-	-	26	13	-	-
	French Island	1	-	-	-	10	1	-	-
	Moncoeur Islands	1	-	-	-	26	8	-	-
	Hogan Island Group	1	-	-	-	9	2	-	-
	Rodondo Island	1	-	-	-	24	13	-	-
	Glennie Group	4	-	-	-	34	21	-	-
	Norman Island	3	-	-	-	33	16	-	-
	Shellback Island	2	-	-	-	24	9	-	-
	Anser Island	2	-	-	-	27	18	-	-
	Kanowna Island	3	-	-	-	18	18	-	-
	Skull Rock	3	-	-	-	16	18	-	-
	Glenelg	4	-	-	-	19	2	-	-
	Warrnambool	5	-	-	-	34	13	-	-
	Moyne	14	4	-	-	87	60	5	-
	Corangamite	14	5	-	-	237	100	21	-
	Colac Otway	30	10	-	-	212	100	51	-
	Surf Coast	4	-	-	-	46	50	-	-
	Greater Geelong	2	-	-	-	26	15	-	-
	Mornington Peninsula	6	-	-	-	52	13	1	-
	Bass Coast	2	-	-	-	24	9	-	-
	South Gippsland	4	-	-	-	43	18	-	-
	Lady Julia Percy Island	2	-	-	-	20	7	-	-

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	Laurence Rocks	1	-	-	-	19	2	-	-
State Waters	Tasmania State Waters	1	-	-	-	15	3	-	-
	Victoria State Waters	34	16	-	-	289	100	57	-
SUB-LGA	Wilsons Promontory (East)	2	-	-	-	31	11	-	-
	Wilsons Promontory (West)	4	-	-	-	33	14	-	-
	Waratah Bay	4	-	-	-	31	18	-	-
	Cape Liptrap (NW)	4	-	-	-	43	16	-	-
	Venus Bay	2	-	-	-	24	9	-	-
	Kilcunda	1	-	-	-	18	7	-	-
	French Island / San Remo	1	-	-	-	8	2	-	-
	French Island / Crib Point	1	-	-	-	8	1	-	-
	Westernport	6	-	-	-	31	6	-	-
	Mornington Peninsula (S)	6	-	-	-	51	12	1	-
	Mornington Peninsula (SW)	4	-	-	-	33	11	-	-
	Port Phillip (Sorrento Shore)	2	-	-	-	26	10	-	-
	Port Phillip Heads	1	-	-	-	14	4	-	-
	Port Phillip (Queenscliff)	2	-	-	-	25	15	-	-
	Torquay	3	-	-	-	44	16	-	-
	Anglesea	4	-	-	-	40	31	-	-
	Lorne	7	1	-	-	57	50	1	-
	Cape Patton	13	3	-	-	124	92	8	-
	Apollo Bay	14	4	-	-	212	100	21	-
	Cape Otway West	30	10	-	-	203	100	51	-
	Moonlight Head	14	4	-	-	237	100	21	-
	Port Campbell	9	3	-	-	112	67	5	-
	Bay of Islands	14	1	-	-	90	60	5	-
	Childers Cove	14	4	-	-	78	24	1	-
	Warrnambool	1	-	-	-	9	3	-	-
	Port Fairy	5	-	-	-	29	3	-	-
	Portland Bay (East)	1	-	-	-	15	1	-	-
	Cape Nelson	4	-	-	-	19	2	-	-

*Concentration recorded over a 48-hour window.
^Instantaneous concentration recorded over one hour.

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10.1.2.2 Entrained Hydrocarbons

Table 25 and Table 26 summarise the probability and maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer at, or above the exposure thresholds during summer and winter.

The maximum entrained hydrocarbon exposure over 48 hour window predicted for the summer and winter season was 559 ppb and 569 ppb, respectively, and hence no moderate or high exposure was predicted. During summer conditions, the probability of low exposure to entrained hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF; Moyne LGA; Bay of Islands and Childers Cove sub-LGAs) to 17% (Otway Plain IBRA; Colac Otway LGA; Cape Otway West sub-LGA and within Victorian State Waters), with the exception of IMCRA – Otway (50%). During winter conditions, the probability of low exposure to entrained hydrocarbons over 48 hours ranged from 1% (Bonney Coast Upwelling KEF; Bay of Islands and Lorne sub-LGAs) to 16% (Victoria State Waters), with the exception of Otway IMCRA (42%).

For the 1 hour exposure window, the entrained hydrocarbon concentrations had peaked at 948 ppb during summer and 932 ppb during winter with the maximum values predicted within the Otway IMCRA During summer conditions, the probability of moderate entrained hydrocarbon exposure ranged from 7% (Cape Patton sub-LGA) to 73% (Victorian State Waters). The probability of exposure to the Otway IMCRA receptor was 100% during both seasons. For other receptors during winter conditions, the probability of moderate entrained hydrocarbon exposure ranged from 8% (along the shoreline of Childers Cove sub-LGA; Moyne and Warrnambool LGA) to 73% (within Victorian State Waters).

Table 25 Predicted probability and maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer during summer conditions.

Receptor		Maximum time-entrained hydrocarbon exposure (ppb) for 48 hour window	Probability of entrained hydrocarbon exposure for 48 hour window			Maximum entrained hydrocarbon exposure (ppb) for 1 hour window	Probability of entrained hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	81	11	-	-	255	98	50	-
AMP	Beagle	12	-	-	-	15	14	-	-
AMP	Murray	7	-	-	-	10	1	-	-
AMP	Zeehan	7	-	-	-	14	8	-	-
IBRA	Glenelg Plain	36	-	-	-	41	45	-	-
IBRA	Bridgewater	32	-	-	-	37	36	-	-
IBRA	Warrnambool Plain	255	5	-	-	293	100	38	-
IBRA	Otway Ranges	184	7	-	-	215	100	29	-
IBRA	Otway Plain	294	17	-	-	333	100	71	-
IBRA	Gippsland Plain	41	-	-	-	47	62	-	-
IBRA	Strzelecki Ranges	18	-	-	-	20	14	-	-
IBRA	Wilsons Promontory	24	-	-	-	28	21	-	-
IMCRA	Coorong	9	-	-	-	13	12	-	-
IMCRA	Otway	559	50	-	-	948	100	100	-
IMCRA	Victorian Embayment	37	-	-	-	42	52	-	-
IMCRA	Central Victoria	117	9	-	-	255	96	50	-
IMCRA	Central Bass Strait	94	6	-	-	220	95	38	-
IMCRA	Flinders	24	-	-	-	28	29	-	-
KEF	West Tasmania Canyons	16	-	-	-	25	16	-	-
KEF	Bonney Coast Upwelling	36	1	-	-	53	74	-	-
MNP	Bunurong	12	-	-	-	14	19	-	-
MNP	Churchill Island	11	-	-	-	13	12	-	-
MNP	Discovery Bay	14	-	-	-	17	20	-	-
MNP	Point Addis	35	-	-	-	41	49	-	-
MNP	Port Phillip Heads	31	-	-	-	35	49	-	-

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	Twelve Apostles	256	6	-	-	302	100	60	-
	Wilsons Promontory	23	-	-	-	26	22	-	-
MP	Lower South East	10	-	-	-	13	16	-	-
NP	Bunurong Marine Park	17	-	-	-	20	36	-	-
	Corner Inlet Marine and Coastal	10	-	-	-	11	2	-	-
	Wilsons Promontory Marine Park	23	-	-	-	27	8	-	-
RAMSAR	Corner Inlet	10	-	-	-	11	2	-	-
	Port Phillip Bay and Bellarine	19	-	-	-	25	39	-	-
	Western Port	21	-	-	-	24	19	-	-
SHORE	Phillip Island	30	-	-	-	35	46	-	-
	Mud Island	23	-	-	-	28	29	-	-
	Moncoeur Islands	12	-	-	-	14	14	-	-
	Rodondo Island	13	-	-	-	17	16	-	-
	Glennie Group	22	-	-	-	25	20	-	-
	Norman Island	24	-	-	-	28	15	-	-
	Shellback Island	23	-	-	-	27	6	-	-
	Kanowna Island	14	-	-	-	16	21	-	-
	Skull Rock	15	-	-	-	17	21	-	-
	Glenelg	36	-	-	-	41	45	-	-
	Warrnambool	34	-	-	-	38	63	-	-
	Moyne	82	1	-	-	90	95	-	-
	Corangamite	255	5	-	-	293	100	30	-
	Colac Otway	294	17	-	-	333	100	71	-
	Surf Coast	47	-	-	-	59	48	-	-
	Greater Geelong	46	-	-	-	52	44	-	-
	Mornington Peninsula	41	-	-	-	47	62	-	-
	Bass Coast	20	-	-	-	23	41	-	-
	South Gippsland	24	-	-	-	27	28	-	-
	Grant	10	-	-	-	14	16	-	-
	Lady Julia Percy Island	33	-	-	-	40	58	-	-
	Laurence Rocks	33	-	-	-	37	46	-	-
State Waters	South Australia State Waters	13	-	-	-	22	17	-	-
	Victoria State Waters	296	17	-	-	336	100	73	-

	Corner Inlet	10	-	-	-	12	3	-	-
	Wilsons Promontory (East)	11	-	-	-	14	17	-	-
	Wilsons Promontory (West)	24	-	-	-	27	20	-	-
	Waratah Bay	18	-	-	-	22	14	-	-
	Cape Liptrap (NW)	20	-	-	-	24	28	-	-
	Venus Bay	17	-	-	-	20	36	-	-
	Kilcunda	20	-	-	-	23	41	-	-
	French Island / San Remo	16	-	-	-	19	24	-	-
	French Island / Crib Point	9	-	-	-	12	9	-	-
	Westernport	25	-	-	-	29	42	-	-
	Mornington Peninsula (S)	33	-	-	-	39	60	-	-
	Mornington Peninsula (SW)	41	-	-	-	47	62	-	-
	Port Phillip (Sorrento Shore)	41	-	-	-	45	53	-	-
	Port Phillip (Mornington)	11	-	-	-	12	18	-	-
	Port Phillip Heads	25	-	-	-	32	41	-	-
SUB-LGA	Port Phillip (Queenscliff)	31	-	-	-	36	44	-	-
	Torquay	46	-	-	-	52	39	-	-
	Anglesea	30	-	-	-	34	38	-	-
	Lorne	48	-	-	-	59	48	-	-
	Cape Patton	78	2	-	-	121	95	7	-
	Apollo Bay	80	4	-	-	139	95	17	-
	Cape Otway West	294	17	-	-	333	100	71	-
	Moonlight Head	255	5	-	-	293	100	30	-
	Port Campbell	155	3	-	-	196	100	27	-
	Bay of Islands	82	1	-	-	90	95	-	-
	Childers Cove	63	1	-	-	72	68	-	-
	Warrnambool	28	-	-	-	34	56	-	-
	Port Fairy	26	-	-	-	31	46	-	-
	Portland Bay (East)	15	-	-	-	18	12	-	-
	Portland Bay (West)	22	-	-	-	25	19	-	-
	Cape Nelson	36	-	-	-	41	45	-	-
	Discovery Bay (East)	11	-	-	-	14	8	-	-

*Concentration recorded over a 48-hour window.
^Instantaneous concentration recorded over one hour.

RPS

Table 26 Predicted probability and maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer during winter conditions.

Receptor		Maximum time-entrained hydrocarbon exposure (ppb) for 48 hour window	Probability of entrained hydrocarbon exposure for 48 hour window			Maximum entrained hydrocarbon exposure (ppb) for 1 hour window	Probability of entrained hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	85	7	-	-	225	100	48	-
	Beagle	18	-	-	-	24	40	-	-
IBRA	King Island	10	-	-	-	14	10	-	-
	Flinders	14	-	-	-	23	19	-	-
	Warrnambool Plain	178	4	-	-	214	100	39	-
	Otway Ranges	168	6	-	-	202	100	47	-
	Otway Plain	303	10	-	-	333	100	58	-
	Gippsland Plain	55	-	-	-	67	83	-	-
	Strzelecki Ranges	22	-	-	-	25	54	-	-
	Wilsons Promontory	69	-	-	-	79	74	-	-
	Bateman	6	-	-	-	6	-	-	-
IMCRA	Batemans Shelf	9	-	-	-	12	8	-	-
	Twofold Shelf	14	-	-	-	23	21	-	-
	Otway	569	42	-	-	932	100	100	-
	Victorian Embayments	28	-	-	-	32	57	-	-
	Central Victoria	112	7	-	-	225	100	48	-
	Central Bass Strait	105	4	-	-	227	100	23	-
	Flinders	72	-	-	-	84	75	-	-
KEF	West Tasmania Canyons	17	-	-	-	21	17	-	-
	Bonney Coast Upwelling	32	1	-	-	42	32	-	-
	Upwelling East of Eden	14	-	-	-	17	21	-	-
MNP	Bunurong	11	-	-	-	15	29	-	-
	Cape Howe	9	-	-	-	9	-	-	-
	Churchill Island	14	-	-	-	16	16	-	-
	Point Addis	34	-	-	-	38	72	-	-
	Port Phillip Heads	25	-	-	-	30	59	-	-
	Twelve Apostles	169	6	-	-	230	100	43	-

	Wilsons Promontory	71	-	-	-	84	74	-	-
AMP	Apollo	85	7	-	-	225	100	48	-
MP	Batemans	7	-	-	-	9	-	-	-
NP	Bunurong Marine Park	16	-	-	-	19	47	-	-
	Corner Inlet Marine and Coastal Park	10	-	-	-	12	10	-	-
	Shallow Inlet Marine and Coastal Park	10	-	-	-	12	9	-	-
	Wilsons Promontory Marine Park	60	-	-	-	67	72	-	-
RAMSAR	Corner Inlet	10	-	-	-	12	10	-	-
	Port Phillip Bay and Bellarine Peninsula	18	-	-	-	23	27	-	-
	Western Port	16	-	-	-	21	30	-	-
RSB	New Zealand Star Bank	7	-	-	-	9	-	-	-
SHORE	King Island	10	-	-	-	14	10	-	-
	Seal Islands	7	-	-	-	11	2	-	-
	Phillip Island	28	-	-	-	33	79	-	-
	French Island	11	-	-	-	18	11	-	-
	Mud Island	15	-	-	-	19	25	-	-
	Curtis Island	8	-	-	-	11	5	-	-
	Moncoeur Islands	18	-	-	-	24	38	-	-
	Hogan Island Group	14	-	-	-	23	19	-	-
	Rodondo Island	19	-	-	-	25	59	-	-
	Glennie Group	68	-	-	-	78	74	-	-
	Norman Island	71	-	-	-	84	74	-	-
	Shellback Island	36	-	-	-	44	69	-	-
	Montague Island	6	-	-	-	9	-	-	-
	Anser Island	41	-	-	-	49	69	-	-
	Kanowna Island	36	-	-	-	42	69	-	-
	Skull Rock	37	-	-	-	42	70	-	-
	Warrnambool	80	-	-	-	137	30	8	-
	Moyne	143	4	-	-	207	72	8	-
	Corangamite	178	5	-	-	214	100	36	-
	Colac Otway	303	10	-	-	333	100	58	-
	Surf Coast	45	-	-	-	50	69	-	-
	Greater Geelong	45	-	-	-	51	54	-	-

	Mornington Peninsula	37	-	-	-	42	83	-	-
	Bass Coast	19	-	-	-	23	52	-	-
	South Gippsland	65	-	-	-	72	73	-	-
	Eurobodalla	6	-	-	-	9	-	-	-
	Lady Julia Percy Island	32	-	-	-	37	24	-	-
	Laurence Rocks	8	-	-	-	12	4	-	-
State Waters	Tasmania State Waters	14	-	-	-	23	21	-	-
	Victoria State Waters	303	16	-	-	333	100	73	-
	New South Wales State Waters	9	-	-	-	13	11	-	-
SUB-LGA	Eurobodalla	6	-	-	-	9	-	-	-
	Corner Inlet	10	-	-	-	12	10	-	-
	Wilsons Promontory (East)	22	-	-	-	27	56	-	-
	Wilsons Promontory (West)	65	-	-	-	72	73	-	-
	Waratah Bay	22	-	-	-	25	54	-	-
	Cape Liptrap (NW)	27	-	-	-	31	66	-	-
	Venus Bay	16	-	-	-	18	45	-	-
	Kilcunda	19	-	-	-	23	52	-	-
	French Island / San Remo	13	-	-	-	15	28	-	-
	French Island / Crib Point	12	-	-	-	19	11	-	-
	Westernport	23	-	-	-	28	64	-	-
	Mornington Peninsula (S)	36	-	-	-	42	83	-	-
	Mornington Peninsula (SW)	37	-	-	-	42	83	-	-
	Port Phillip (Sorrento Shore)	31	-	-	-	35	75	-	-
	Port Phillip Heads	24	-	-	-	29	46	-	-
	Port Phillip (Queenscliff)	29	-	-	-	36	50	-	-
	Torquay	45	-	-	-	51	34	-	-
	Anglesea	29	-	-	-	34	49	-	-
	Lorne	39	1	-	-	50	69	-	-
	Cape Patton	67	3	-	-	95	99	-	-
	Apollo Bay	70	4	-	-	132	100	11	-
	Cape Otway West	303	10	-	-	333	100	58	-
	Moonlight Head	178	4	-	-	214	100	36	-
	Port Campbell	127	3	-	-	182	91	11	-

Bay of Islands	84	1	-	-	104	72	2	-
Childers Cove	143	4	-	-	207	46	8	-
Warrnambool	16	-	-	-	22	21	-	-
Port Fairy	12	-	-	-	16	14	-	-
Portland Bay (East)	9	-	-	-	11	2	-	-

*Concentration recorded over a 48-hour window.
^Instantaneous concentration recorded over one hour.

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Appendix C EP Revision Change Register

Any changes to the EP should be assessed against the OPGGS(E)R revision submission criteria detailed in Table 8-11.

Date	EP Revision	Section Revised	Changes	MOC No.	EP Submission Required
28/5/2020	4	Throughout	Removed reference to Diamond and the Ocean Onyx. No change to impacts and risk assessment.	NA	NA
28/5/2020	4	Section 7 IMS	Inclusion of reference to Beach Introduced Marine Species Management Plan (S400AH719916). No change to impacts and risk assessment.	NA	NA
28/5/2020	4	Section 7 IMS	Include that the MODU may also already be in Victorian waters. Risk assessment takes into account MODU will be mobilised from Victorian waters.	NA	NA
8/6/2020	4	Section 7.19 Oil spill response	Removed reference to rigs in Australia at time of writing. Updated as per accepted WOMP. No change to impacts and risk assessment.	NA	NA
1/7/2020	4	Throughout	Change in timing from Q1 or Q2 2020 to the period from Q3 2020 to the end of 2021. There is no change in the days to drill the well which remains between 35 to 55 days.	ENV-MOC-006	Yes
1/7/2020	4	Throughout	Change southern right whale distribution BIA to current core coastal range. No change to impacts and risk assessment.	NA	NA
1/7/2020	4	Section 1 Overview of activity	Changed reference to the MODU going into Port Phillip Bay to Victorian waters. No change to impacts and risk assessment.	NA	NA
1/7/2020	4	Throughout	Changed to titleholders from Lattice Energy Limited to Beach Energy (Operations) Limited. No change in the manner in which impacts and risk are managed.	NA	NA
1/7/2020	4	Section 4.5.2.1 MODU position and mooring	Inclusion of information in relation to the prelaid anchors.	ENV-MOC-006	No
1/7/2020	4	Section 5 Existing environment	Inclusion of noise behaviour EMBA and previous noise EMBA is noise 24 hr EMBA.	NA	NA

Date	EP Revision	Section Revised	Changes	MOC No.	EP Submission Required
1/7/2020	4	Section 5.5.13.1 Bonney coast upwelling KEF	Changed information to be specific to the Bonney coast upwelling KEF. Added new Section 5.6.8 Bonney coast upwelling to cover information about the upwelling.	NA	NA
1/7/2020	4	Section 5.6.1 Otway assessment and surveys EMBA	Updated with latest information from the Otway seabed survey.	NA	NA
1/7/2020	4	Section 5.6.5 Water quality	Updated with latest water quality data from the Otway seabed survey.	NA	NA
1/7/2020	4	Section 5.6.8 Bonney coast upwelling	Added section with information regarding Bonney coast upwelling	NA	NA
1/7/2020	4	Section 5.8.2 Petroleum exploration	Updated with latest information from NOSPEMA website.	NA	NA
1/7/2020	4	Section 5.8.6 Commonwealth Fisheries	Updated with latest ABARES report information.	NA	NA
1/7/2020	4	Section 7.2 Light emissions	Updated to reflect drilling may occur at any time in the year. No change to impacts or risk as only the orange bellied parrot has a seasonal component and the original drilling period of Q1 or Q2 overlap the migration period of late February to early April.	ENV-MOC-006	No
1/7/2020	4	Section 7.4 Underwater noise emissions	Section updated with Jasco noise modelling results.	NA	Yes
1/7/2020	4	Section 7.5 Physical presence	Updated to reflect drilling may occur at any time in the year. No change to impacts or risk as original drilling period of Q1 or Q2 overlapped fishing periods. Updated to reflect that the MODU anchors are already laid and include anchor chain on the seabed.	ENV-MOC-006	No

Date	EP Revision	Section Revised	Changes	MOC No.	EP Submission Required
1/7/2020	4	Section 7.6 Benthic disturbance	Updated to reflect that the MODU anchors are already laid and include anchor chain on the seabed.	ENV-MOC-006	No
1/7/2020	4	Section 7.13 Entanglement of fauna	Addition of new risk entanglement of fauna.	ENV-MOC-006	No
1/7/2020	4	Section 7.17 LOC Diesel Spill Section 7.18 LOWC	Updated timing for cetacean assessment. No change to impacts or risk as original drilling period of Q1 or Q2 overlapped period of blue whale foraging and when southern right whales within the EMBA.	ENV-MOC-006	No
1/7/2020	4	7.19 Source control	Updated timing in relation to availability of suitable rig for relief well.	NA	NA
1/7/2020	4	Section 7.20 EPOs, EPS	Addition of EPO for air emissions. Update to include new control measures and EPS. Addition of EPSs and MC for new and updated impacts and risks.	NA	NA
1/7/2020	4	8.9.1 Incident reporting	Inclusion of loss of anchor buoy.	NA	NA
1/7/2020	4	Section 8.24.2 EP review	Inclusion of subscription to the NOPSEMA website to identify any new petroleum activities within the Otway Basin that may overlap with the Artisan-1 drilling location and timing	NA	NA
10/7/2020	4	Section 9.7 Ongoing Stakeholder consultation	Table 7-4 Updated with additional information provided to stakeholders in relation to resubmission of the EP to NOSPEMA, change in drilling period, notification that the anchors and PSZ in place.	ENV-MOC-006	Yes
8/7/2020	4	OSMP Addendum	Updated for change to timing and review of RPS study leads.	ENV-MOC-006	Yes
10/7/2020	3	Sensitive information	Updated to include stakeholder information provided 21 April 2020, 8 May 2020 and 10 July 2020.	NA	NA

Appendix D Commercial Fisher Operating Protocol

Beach Energy Otway Development Seabed Survey and Drilling Program
Commercial Fisher Operating Protocol
1 July 2019

This protocol will be undertaken by Beach Energy (Beach) for the Otway Development Seabed Survey and Drilling Programs with Fishers who have identified they fish in the area of the seabed surveys and/or well locations.

The aim of this Commercial Fisher Operating Protocol is to ensure that Beach and Fishers may continue their activities without unduly impacting on each other. These protocols are:

- Beach will notify Fishers a minimum of 4 weeks prior to the commencement of the seabed surveys and drilling program and provide the following information:
    - type of activity;
    - location of activity, coordinates and map;
    - timing of activity: expected start and finish date and duration;
    - sequencing of locations if applicable;
    - vessel or rig details including call sign and contact;
    - requested clearance from other vessels; and
    - Beach contact details.

  Note: coordinates will be provided as degrees and decimal minutes referenced to the WGS 84 datum.
- Beach will consider any reasonable requests to change the sequencing of a survey, however, where a change cannot be accommodated, Beach will inform the Fisher as to the reasons in a timely manner.
- Once the seabed surveys commence, Beach will provide regular (most likely daily) SMS messaging system updates on the locations the vessel will be operating and the expected duration, so Fishers can plan their fishing activities with the least disruption. Beach will request Fishers who wish to receive these SMS updates, to provide their mobile phone number, so they can be included in the distribution list. Beach will also have the vessel master put out daily radio messages on channel 16. The survey vessel will have AIS and so will be able to track any larger fishing vessels in their immediate area.
- The MODU exclusion zone (500 m) will be communicated via Notice to Mariners. Fishers are to contact channel 16 if they wish to communicate with the rig at any time. The rig will be stationary until it is required to move to the next location. Beach will provide SMS messaging system updates 2 days prior to the rig moving to a new location detailing the new location and the expected duration at the location so Fishers can plan their fishing activities with the least disruption. Beach has undertaken an assessment of the Commonwealth and Victorian fisheries that overlap with the project's operational area and has identified low levels of fishing in this area.
- Where Fishers provide Beach with sensitive fishing data, Beach will maintain the confidentiality of that data as per Beach's privacy policy.

Given this assessment has identified low levels of fishing and commercial fisheries cover a vast area vs. Beach's seabed surveys and drilling that will only access a relatively small area over a short period of time, Beach's approach is to constructively work with Fishers in order to minimise impact to each other's activities. However, Beach has a stated position that Fishers should not suffer an economic loss as a result of our activities. Should a Fisher incur additional costs in order to work around our activities, or if they have lost catch, or have damaged equipment, Beach will assess the claim and ask for evidence, including, past fishing history and the loss incurred. Where the claim is genuine, Beach will provide compensation and will also ensure that the evidence required is not burdensome on the Fisher whilst ensuring genuine claims are processed.

Appendix E Environmental Survey – Otway Basin

SUPPLIER DOCUMENT COVER PAGE

Project Title	Beach Otway Offshore Wellsite Survey Services		
Supplier Name	Ramboll		
Contract/PO No	TBC		
Document Title	Infauna Laboratory Testing and Factual Report		
Fugro Document Number	135846-V01-05-REP-001	**Revision**	B
Client Document Number	S4100RU718410	**Revision**	A
Supplier Document Number	3180000803	**Revision**	B
Sub-Supplier Document Number		**Revision**	
VDRL Code			
Tag No			

Supplier/Contractor Internal Approvals (Supplier/Contractor use only)

Date	Rev	Reason for Issue	Prepared By	Checked By	Supplier/Contractor Approval
17/03/20	A	Issued for Review	E Jones	D McClary	J Miragliotta
23/04/20	B	Issued for Review	E Jones	D McClary	J Miragliotta

Review Status (Fugro use only)

Tick Box	Code	Review Status Description
☐	Code 1	Approved – Certified Final
☐	Code 2	Approved as noted – Revise and resubmit as final revision, work may/may not proceed
☐	Code 3	Not accepted – Revise and resubmit for review
☐	Code 4	Information only – Review not required
☐	Code 5	No Comments – Submit certified final
☐	Code 6	As Built

Acceptance in any of these categories in no way relieves the Supplier/Contractor of their responsibility for the due and proper performance of the works in accordance with the Contract/Purchase Order with Fugro.

Fugro Approval

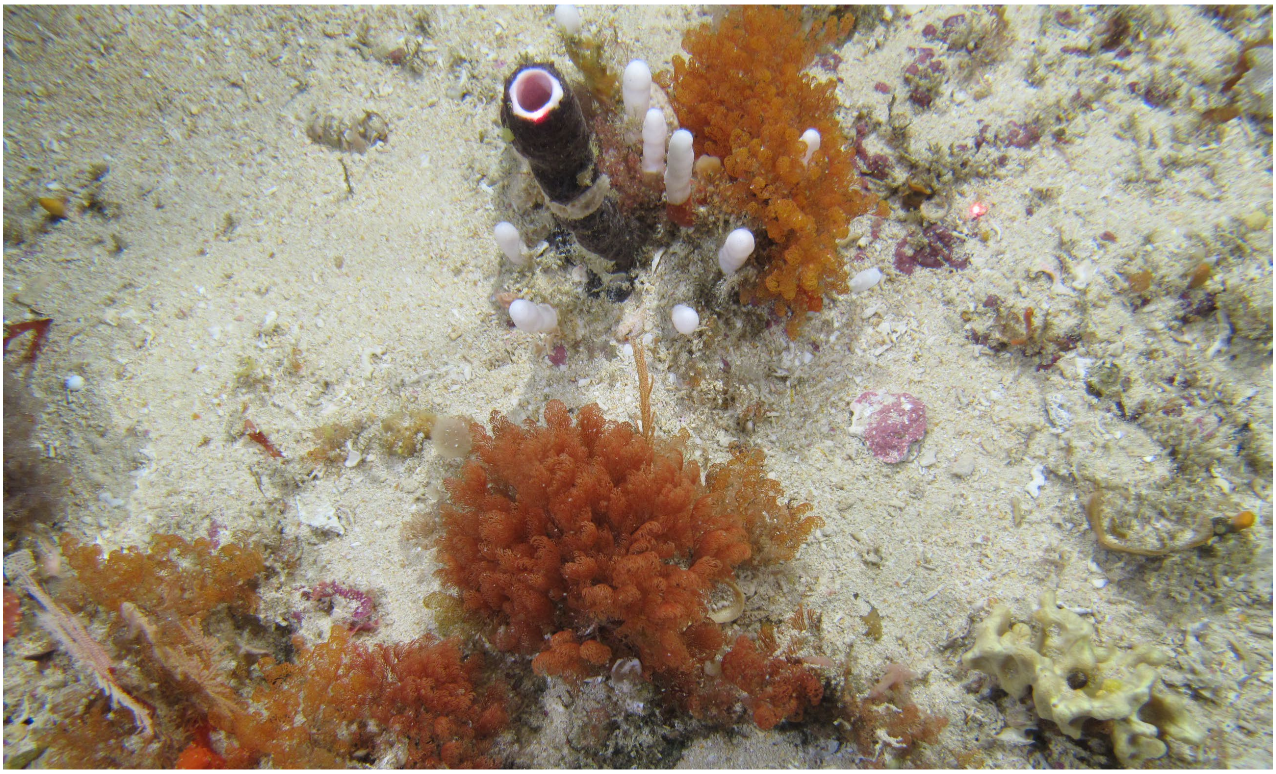
Name	
Signature	
Date	

Intended for
Fugro Australia Pty Ltd

Document type
Report

Date
March 2020

ENVIRONMENTAL SURVEY
OTWAY BASIN



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ENVIRONMENTAL SURVEY
OTWAY BASIN

Project name	**Beach Energy Otway Basin Survey**
Project no.	**318000803**
Recipient	**Chris Henderson**
Document type	**Report**
Version	**Rev B**
Date	**17/03/2020**
Prepared by	**Emily Jones**
Checked by	**Dan McClary**
Approved by	**John Miragliotta**
Description	**Results of the environmental survey at Otway Basin for Beach Energy**

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1. INTRODUCTION

1.1 Background

This report presents the results of the environmental survey of offshore gas fields in Otway Basin for Beach Energy. Beach Energy is planning further development of the Otway offshore natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The offshore Otway Basin gas exploration and development program may include drilling up to nine wells using a contracted semi-submersible drill rig, over a 12- to 18-month period. Additional seabed infrastructure would also be installed to tie-in new wells after the drilling phase.

As part of this plan, Fugro Australia Marine Pty Ltd (Fugro) carried out offshore geophysical and geotechnical surveys and Ramboll Australia Pty Ltd (Ramboll) were contracted by Fugro to carry out the environmental survey. These activities were in Commonwealth waters approximately 32 to 80 km from Port Campbell and in water depths ranging from 70 to 104 m.

1.2 Objective

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

1.3 Report Scope

The scope of the environmental survey carried out in Otway Basin included investigations of:

- Water quality;
- Sediment quality;
- Benthic infauna; and
- Benthic epifauna.

Water quality assessments included laboratory analyses for:

- Suspended solids
- Nutrients
- Chlorophyll *a*
- Metals/metalloids
- Hydrocarbons

Sediment quality assessments included laboratory analyses for:

- Sediment particle size
- Total organic carbon
- Nutrients
- Metals/metalloids

Infauna were microscopically examined to determine taxonomic identification to Family level and morpho-species, and abundance was recorded. The composition and percent cover of epifauna was determined from seabed photographs.

2. SURVEY LOCATIONS

These investigations were based around five survey areas including:

- Thylacine;
- Artisan;
- La Bella;
- Geographe; and
- Hercules.

Other survey areas included two Hot Tap sites identified as HTX and HTY, and five routes selected for cone penetration tests (CPT) as part of the geotechnical survey plan identified as ARGE (Artisan to Geographe), ARHTX (Artisan to HTX), ARHTY (artisan to HTY), ARLB (Artisan to La Bella) and LBGE (La Bella to Geographe).

The collection of water and sediment/infauna samples for environmental assessment was cancelled by the client for the La Bella, Geographe and Hercules survey areas. Therefore, the collection of water and sediment/infauna samples for environmental assessment occurred only at the Thylacine and Artisan survey areas. Seabed photographs were taken as planned for all survey areas and routes. It is also noted that all survey areas were largely composed of outcropping rock with or without patches of uncemented sediments. Sampling of uncemented sediments was only possible with the grab sampler (as opposed to other devices) and of limited recovery because of the limited thickness of the surficial uncemented sediments.

The survey extent within Otway Basin, including these survey areas, hot taps and survey routes, is shown Figure 1. Environmental sampling sites were located in proximity to the proposed drilling rig mooring locations. The proposed anchor points for the drilling rig are listed in Table 1. The depth at each proposed mooring location was measure at the intersection of the anchor lines (Table 1). Sampling locations are listed in Section 3 for the relevant sampling methods.

Table 1 Location of proposed anchor points (GDA94 UTM 54 S) and water depth for drilling rig sites.

Survey Area	Anchor Point	Depth at Intersection (m LAT)	Easting	Northing
Thylacine	Thylacine 1	99	661398	5657534
	Thylacine 2		662879	5658389
	Thylacine 3		662361	5659286
	Thylacine 4		660880	5658431
	Thylacine 5	104	658235	5656067
	Thylacine 6		659717	5656923
	Thylacine 7		659198	5657820
	Thylacine 8		657717	5656965
Artisan	Artisan 1	70	662783	5692700
	Artisan 2		664261	5693554
	Artisan 3		663741	5694456
	Artisan 4		662262	5693602
Geographe	Geographe 1	83	668221	5668522
	Geographe 2		669699	5669374
	Geographe 3		669179	5670278
	Geographe 4		667700	5669424
La Bella	La Bella 1	93	647914	5681579
	La Bella 2		645915	5681579
	La Bella 3		647319	5682496
	La Bella 4		646437	5680702
Hercules	Hercules 1	73	664065	5688642
	Hercules 2		662065	5688638
	Hercules 3		663547	5689516
	Hercules 4		662596	5687757

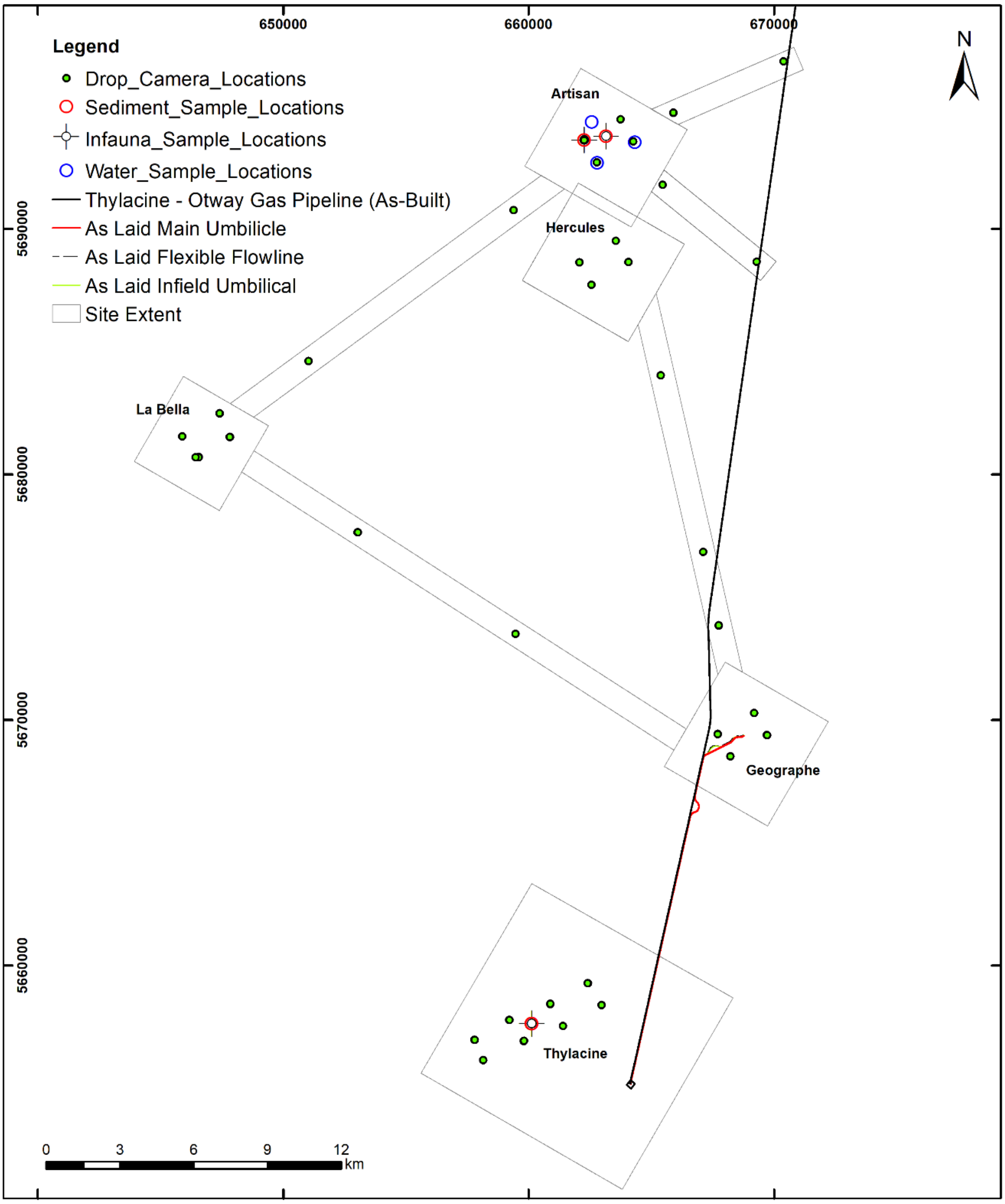


Figure 1 Locations of environmental survey site extents in Otway Basin. Provided by Fugro, April 2020.

3. METHOD

3.1 Survey Operations

The environmental survey was undertaken during several deployments from November 2019 to January 2020. The survey was carried out from the 60 m offshore supply ship *VOS SHINE*. The vessel mobilised from Portland, Victoria.

3.2 Water Quality

3.2.1 Sample Collection

Water quality samples were collected using a 2.2 L Van Dorn Beta water sampler. This sampler was used to obtain water samples from selected water depths. The sampler consisted of an open-ended, clear plastic cylinder with a rubber cap attached at each end. Before deployment, the end caps were held open, under tension, by triggers on the side of the cylinder. The sampler was attached to a rope and lowered by hand over the side of the vessel to the desired depth. A messenger weight attached to the rope was then released to trigger the end caps to close as the messenger contacted the sampler, sealing the water sample inside the cylinder. The sampler was then raised to the surface where the water sample was processed and stored for laboratory analysis.

On retrieval at the surface, the water sampler was inspected against the following sample acceptability criteria:

1. The sample bottle was full; and
2. Both end caps are fully closed; and
3. There was no obvious contamination (e.g. grease or paint chips on, or inside, the sampler).

Any sample that did not comply with these criteria was discarded and another sample was collected at the same site. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

Water samples were collected at two of the survey areas – at Artisan and Thylacine on 22 November 2019. Three replicate water samples were collected at each of the survey areas. The locations for water sample collection are listed in Table 2 and shown in Figure 2. Note that there is only one sampling site indicated for the Thylacine field as all samples were collected in close proximity (Figure 2 left). The process described above was carried out at each site and water samples were collected from a depth equal to half of the total water depth at that site.

Table 2 Location (GDA94 UTM 54 S) and depth of water sample collection sites.

Survey Area	Location	Replicate Sample Name	Easting	Northing	Water Depth (m)	Sample Depth (m)	Met Acceptability Criteria
Thylacine	1	1	660119	5657621	104	52	Yes
	1	2	660121	5657619	104	52	Yes
	1	3	660122	5657619	105	52.5	Yes
Artisan	1	1	662936	5692724	66	33	No
	1	2	662782	5692683	66	33	Yes
	2	1	664317	5693523	66	33	Yes
	5	1	662563	5694337	66	33	Yes

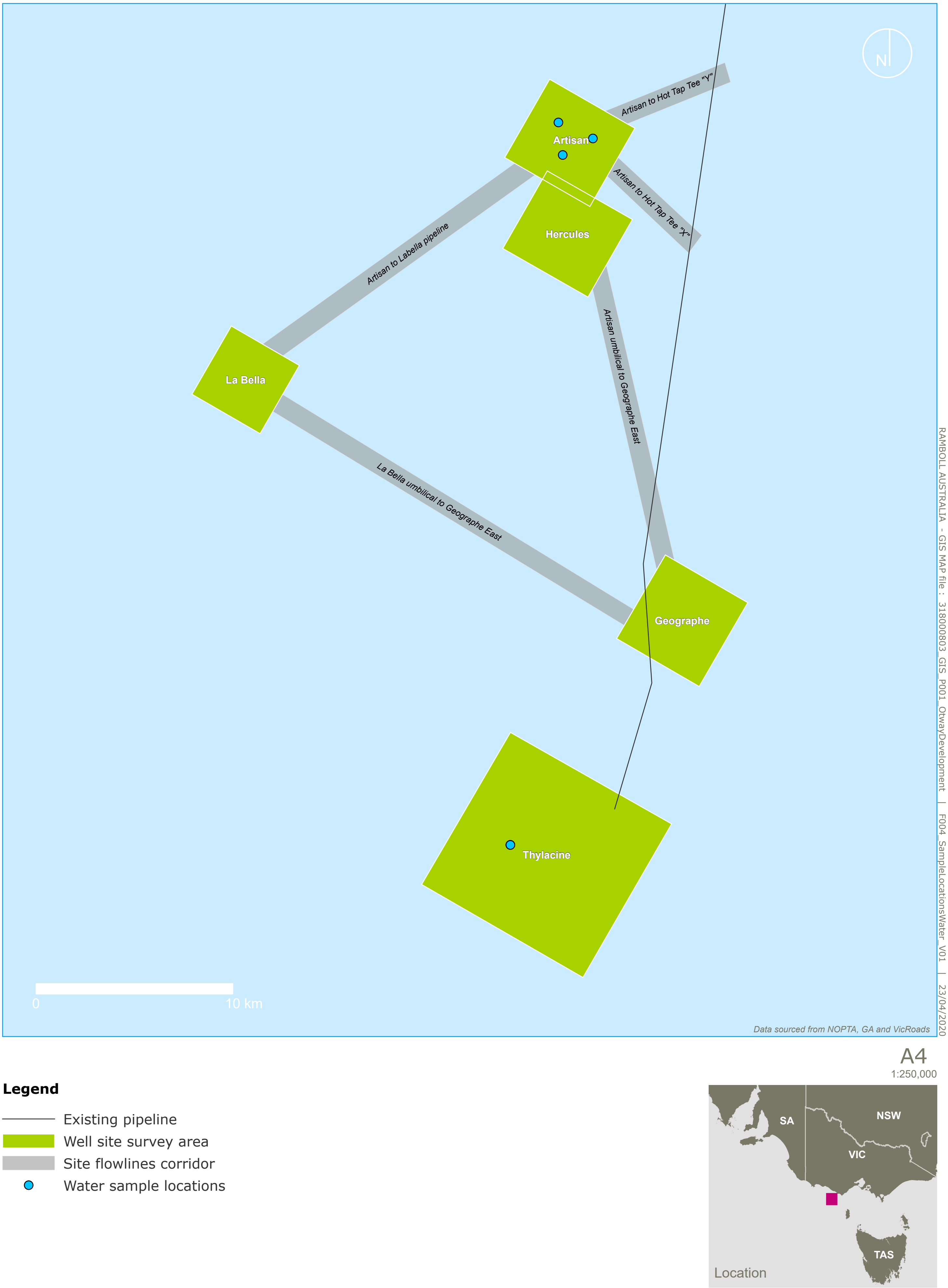


FIGURE 2 | Water sampling locations for Thylacine and Artisan survey areas.

3.2.2 Sample Processing and Analysis

Once a sample was confirmed to be acceptable for analysis, the subsamples were extracted from the water sampler and stored in pre-labelled sample jars provided by the analytical laboratory, Eurofins. The analytical laboratory was NATA accredited and accredited for compliance with ISO/IEC 17025 – Testing.

The water samples were subsampled as follows:

- 1 x 500 mL plastic bottle with no preservative
- 1 x 200 mL glass bottle with no preservative
- 1 x 60 mL plastic bottle with sulphuric acid
- 1 x 60 mL plastic bottle with nitric acid
- 2 x 40 mL glass vials with hydrogen chloride

All samples were stored in a cool, dark location prior to transfer to the laboratory.

One litre of the remaining water sample was then processed for chlorophyll analysis. A simple filtering system was set up which included a Büchner funnel with a rubber seal placed in the mouth of a conical flask and a rubber hose and vacuum hand pump attached to the side arm of the flask. Filter paper (11 µm particle retention at 98% efficiency) was used placed in the funnel and the 1L subsample was suctioned through the filtering system. The filter paper was carefully removed from the funnel using forceps, wrapped in aluminium foil, stored in a labelled sealable plastic bag and frozen prior to transfer to the laboratory.

The following measurements were then taken using a YSI EcoSense handheld meter from the remaining water sample:

- pH
- Dissolved oxygen (DO)
- Oxidation-reduction potential (ORP)
- Temperature (˚C)

Sample information was recorded on the Environmental Sample Log (Appendix 1). All sample collection and processing equipment was then rinsed in sterile demineralised water before the next sample was collected.

All water quality subsamples were recorded on the Ramboll Chain of Custody (COC) form. These subsamples were then transferred to the laboratory on the vessel’s return to shore. The water quality samples were delivered to the Eurofins laboratory in Melbourne on 26 November 2019.

The water samples were analysed for the presence and concentration of these analytes:

- Total suspended solids (TSS);
- Nutrients including total nitrogen (N), total Kjeldahl nitrogen (TKN), nitrogen oxides (NOx), nitrate (NO^{-}_{3}), ammonia (NH_3), total phosphorus (TP), and total reactive phosphorus (TRP);
- Chlorophyll *a*;
- Metals/metalloids including arsenic (As), cadmium (Cd), cobolt (Co), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn); and
- Hydrocarbons including total recoverable hydrogens (TRH), benzene, toluene, ethylbenzene and xylene compounds (BTEX), and polycyclic aromatic hydrocarbons (PAH).

The analytical methods for these analytes are included in the laboratory reports in Appendix 2.

3.3 Sediment Quality

3.3.1 Sample Collection

Seabed sediment samples were collected using a Double Van Veen grab sampler. The Double Van Veen grab is designed for sampling the top layer of consolidated sediment consisting of silt and/or sand. The capacity of each grab bucket is ~12 L. The double grab allows for comparable sampling where samples for sediment and biological analysis are required from the same location.

Prior to deployment, the jaws of both grabs were opened and fixed into position using a tension-based catch. The grab sampler was then winched over the stern of the vessel and lowered at a slow, steady rate to prevent the catch from being released too early. When the jaws made contact with the bottom, the release of tension caused the catch to be tripped, allowing the jaws to quickly close to capture the surface sediment. The quantity and quality of the sample was related to the compactness of the sediment whereby the grab sampler returned less sample content from more compacted sediments.

On retrieval at the surface, the grab sampler was inspected against the following sample acceptability criteria:

1. The jaws of the grab are closed; and
2. The surface of the sediment sample covers at least 70% of the grab; and
3. The surface of the sediment sample is undisturbed; and
4. There is no evidence of the sample being washed out; and
5. The sample is at least 20cm deep.

Samples that did not comply with these criteria were typically discarded and another sample was collected at the same site. However, some exceptions to these criteria were allowed on agreement with the client in order to obtain samples for analysis, given the difficulty of obtaining grab samples from the hard seabed substrate. Such instances are noted in the description of results in Section 4. At some sample locations a composite sample was made from several grab drops (up to three drops) to provide enough material for one sample. In these instances, the samples did not achieve a depth of 20 cm. The first sample replicate collected from the Thylacine survey area (Thylacine_1_1) was 15 cm deep and therefore did not meet the acceptance criteria; however, given the difficulty in obtaining suitable samples (owing to the hard seabed), this sample was retained for analysis as all other criteria were met and it was considered to be a useful sample by the field personnel. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

Sediment samples were collected at two of the survey areas – at Artisan and Thylacine on 22 November 2019. Three replicate sediment samples were to be collected at each of the survey areas, however, this was not always possible because of the compacted substrate. The resulting samples included four replicate samples from Thylacine and two replicate samples from Artisan. The locations for successful sediment sample collection are listed in Table 3 and shown in Figure 3. Note that there is only one sampling site indicated for the Thylacine field as all samples were collected in close proximity (Figure 3 left). Grab sample positions were provided by Fugro from the marine survey using Ultra Short Base Line positioning systems.

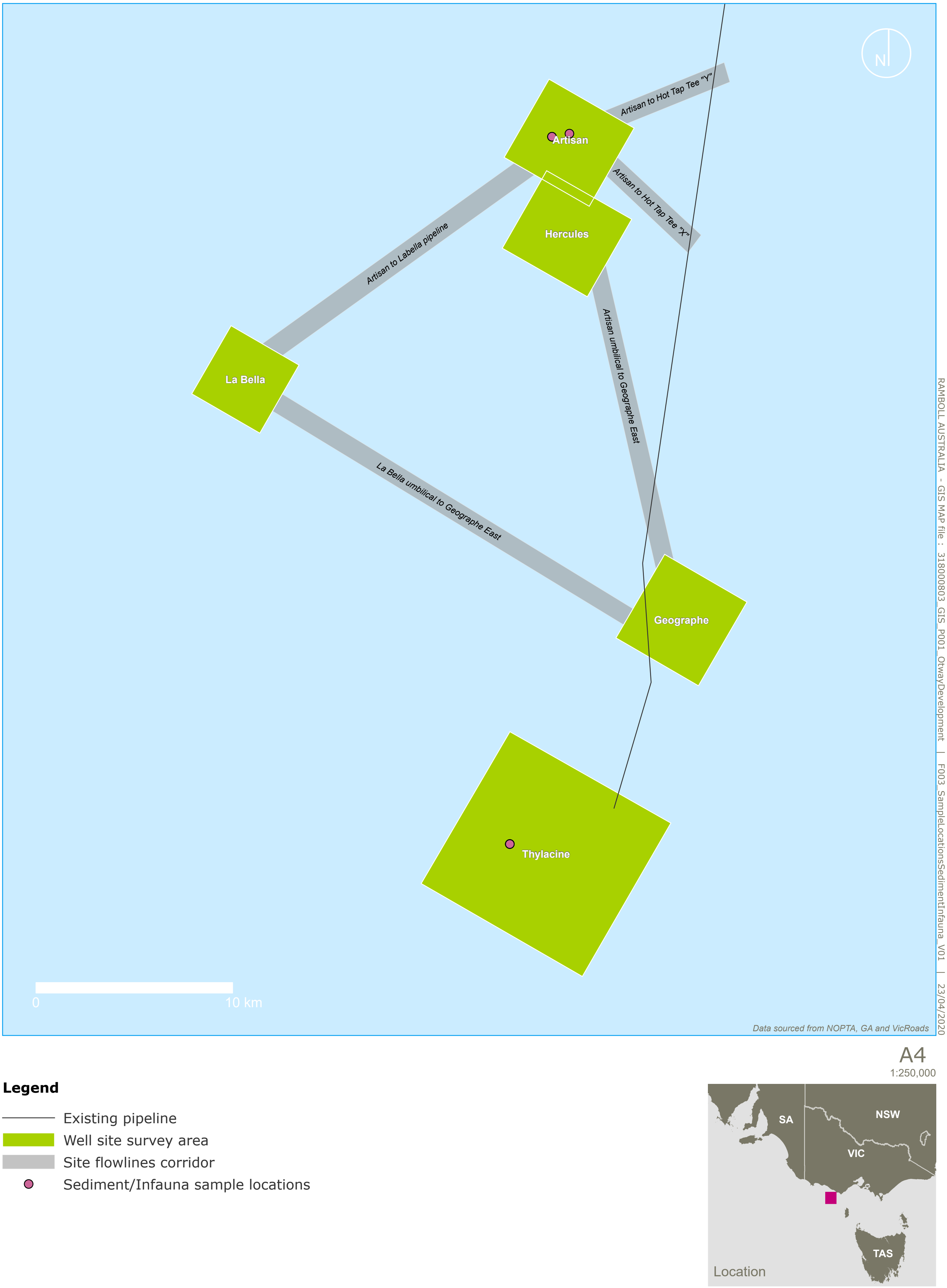


FIGURE 3 | Grab sample locations for sediment and infauna for Thylacine and Artisan survey areas.

Table 3 Location (GDA94 UTM 54 S) and depth of sediment sample collection sites.

Survey Area	Location	Sample Replicate Name	Easting	Northing	Water Depth (m)	Met Acceptability Criteria
Thylacine	1	0	660119	5657621	104	Sample was 15 cm deep, therefore not within acceptance criteria but considered suitable by field personnel. Incorrectly recorded in lab report as Location 2.
	1	1	660121	5657619	104	Yes
	1	2	660122	5657619	105	Yes
	1	3	660120	5657622	104	Yes
Artisan	1	1	663155	5693762	72	This sample was a composite of replicate samples 1, 3, 4 and 6 taken at the same location. Listed as Artisan_GS_A in lab report.
	1	2	663155	5693762	72	No
	1	3	663155	5693762	72	Composite as above.
	1	4	663155	5693762	72	Composite as above.
	1	5	663155	5693762	72	No
	1	6	663155	5693762	72	Composite as above.
	3	1	662264	5693604	75	No
	3	2	662264	5693604	72	No
	3	3	662265	5693604	73	Yes. Listed as Artisan_GS3 in lab report.
	3	4	662265	5693605	74	No sediment sample, infauna sample only.

3.3.2 Sample Processing and Analysis

Once a sample was confirmed to be acceptable for analysis, the sample was photographed, visual observations were recorded, and subsamples were extracted from the sample and stored in pre-labelled sample jars provided by the analytical laboratory.

All sediment grab samples were photographed with a sample identity plate. Notes of the uniformity of the surface, Munsell colour and odour were then recorded. The redox (reduction–oxidation reaction) potential depth (RPD) was measured using a YSI EcoSense handheld meter and probe. Redox potential is a measure of the tendency of a chemical species to acquire electrons from or lose electrons to an electrode and thereby be reduced or oxidised, respectively. Redox potential is measured in millivolts (mV). The redox potential of the sample was measured from the surface and at 10 mm increments to a depth of up to 110 mm, or until resistance was encountered when inserting the probe. The probe was rinsed in fresh water between each sample. Sample information was recorded on the Environmental Sample Log (Appendix 1).

Sediment was then extracted from one grab bucket for sediment quality sampling (with the contents of the other grab bucket being used for infauna sampling). Subsamples were collected by releasing the sample into a collection bin below the sampler. The entire sample was homogenised using a plastic scoop.

Two subsamples were stored in pre-labelled 250 mL glass sample jars for the analysis of contaminants and particle size distribution. All samples were stored in a cool, dark location prior to transfer to the laboratory. All sample collection and processing equipment was then rinsed in fresh water before the next sample was collected.

All sediment quality subsamples were recorded on the Ramboll COC form. These subsamples were then transferred to the laboratory on the vessel's return to shore. The sediment quality samples were delivered to the Eurofins laboratory in Melbourne on 26 November 2019.

The sediment samples were analysed for the presence and concentration of these analytes:
- Sediment particle size as clay-size fraction, silt and sand;
- Total organic carbon (TOC);
- Nutrients including nitrate and nitrite, TKN, total nitrogen, phosphorus, and silicon;
- Metals/metalloids including cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), tin (Sn), and zinc (Zn).
- Hydrocarbons including Total Petroleum Hydrocarbons (TPH) , total polycyclic aromatic hydrocarbons (PAH) and BTEX (benzene, toluene, ethylbenzene and xylenes, PCBs.

The analytical methods for these analytes are included in the laboratory reports in Appendix 3.

3.4 Infauna Ecology

3.4.1 Sample Collection
Seabed sediment samples for infauna were collected using a Double Van Veen grab sampler, as described in Section 3.2.1 and at the locations presented in Table 4 and Figure 3. The critiera for accepting grab samples for infauna analysis were as described in Section 3.2.1. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

3.4.2 Sample Processing and Analysis
Once a sample was confirmed to be acceptable for analysis, the sample was photographed with a sample identity plate. Sediment was then extracted from one grab bucket for infauna sampling (with the contents of the other grab bucket being used for sediment quality sampling). The entire sample was released into a collection bin below the sampler and then transferred to a sample washing system where the sample was placed in a perforated bin to be mixed and rinsed with seawater. The liquified sample was then passed through a series of sieves of 1mm mesh size (top) and 500 µm mesh size (bottom). The remaining infauna and debris were then rinsed into a labelled container and preserved in ethanol at a dilution factor of 2:1 to sample volume. Where a full grab sample was collected, the contents were subsampled to a 6L sample volume to limit the time required for infauna sample processing in the laboratory.

All samples were stored in a chemical locker and were recorded on the Ramboll COC form. These samples were then transferred to the taxonomic analyst on the vessel's return to shore. The laboratory in Gladstone, Queensland received the infauna samples in December 2019.

Infauna organisms present in the samples were identified and counted to Family morpho-species or genus level where possible. Descriptive statistics (e.g., species richness, organism abundance, diversity indices) were used to summarise the seabed biota present. This information is assessed and discussed in the context of the known communities present in the wider Otway Basin, noting the presence of any habitats/species of relevance to the EPBC Act. Multivariate measures were not used in the assessment because of the small dataset and paucity of organisms found in the samples.

Table 4 Location (GDA94 UTM 54 S) and depth of infauna sample collection sites.

Survey Area	Location	Sample Replicate Name	Easting	Northing	Water Depth (m)	Met Acceptability Criteria
Thylacine	1*	0	660119	5657621	104	Sample was 15 cm deep, therefore not within acceptance criteria but considered suitable by field personnel. Incorrectly recorded in lab report as Location 2.
	1	1	660121	5657619	104	Yes
	1	2	660122	5657619	105	Yes
	1	3	660120	5657622	104	Yes
Artisan	1	1	663155	5693762	72	No
	1	2	663155	5693762	72	No
	1	3	663155	5693762	72	No
	1	4	663155	5693762	72	Yes
	1	5	663155	5693762	72	No
	1	6	663155	5693762	72	No
	3	1	662264	5693604	75	No
	3	2	662264	5693604	72	No
	3	3	662265	5693604	73	Yes
	3	4	662265	5693605	74	Sample was 7 cm deep, therefore not within acceptance criteria but considered suitable by field personnel.

3.5 Epibenthic Ecology

3.5.1 Sample Collection

The composition and percent coverage of epifauna was assessed from photographs of the seafloor taken with the Fugro drop camera system. The drop camera system was fitted with a 14.7 megapixel (MP) Canon PowerShot G10 digital camera and a low latency, live video recorder. The system was equipped with twin lasers aimed within the camera field of view to enable calibration of the image size. The lasers were calibrated to a distance of 15 cm. The camera housing was an aluminium enclosure for use in water depths up to 300 m. A mini beacon was attached to the drop camera to accurately track locations during deployment.

The drop camera was deployed via a winch over the stern of the vessel. All data was transferred directly to the surface unit and saved into a dedicated Fugro server. A real-time video feed to the surface enabled preliminary observations of benthic fauna and substrate type to be made during operation.

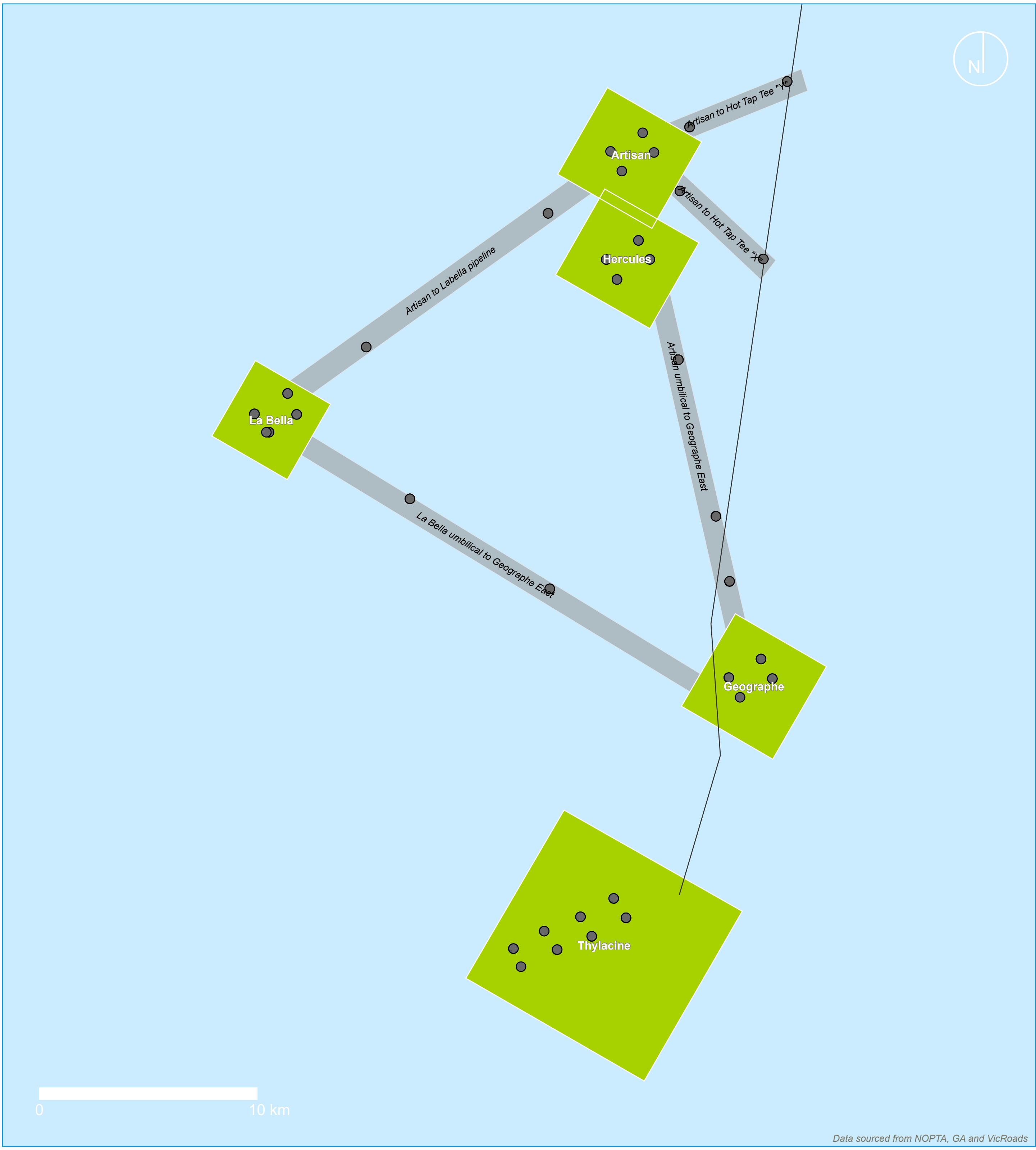
At each sampling site the camera was lowered and then to three locations approximately 1-2 m apart to obtain a collection of representative samples. At least five photographs were taken at each location to provide a selection of photographs for analysis. Drop camera sites are listed in Appendix 4. Drop camera photographs were taken at all anchor points, hot tap sites and along CPT routes as shown in Figure 4. The average area of seabed in each photograph was 0.5 m^2.

3.5.2 Sample Processing and Analysis

All seafloor photographs were examined to determine their suitability for analysis, with photographs being excluded for the assessment based on the following reasons:

- Poor resolution or blurred image;
- Sediment blow out obscuring the image;
- More than a quarter of the image was in shadow or had poor lighting;
- Images were overlapping (in which case the best quality image was chosen); or
- Images were taken at oblique angles.

For each photograph, the percent coverage of epifauna was estimated and individual, mobile organisms were counted. Photographs were examined to provide a qualitative description of the epifauna communities. Sediment type and percent coverage was also estimated for each photograph.



RAMBOLL AUSTRALIA - GIS MAP file : 318000803_GIS_F001_OtwayDevelopment | F002_DropCameraLocations_V01 | 23/04/2020

A4
1:250,000

Legend

- Existing pipeline
- Well site survey area
- Site flowlines corridor
- Drop camera locations

FIGURE 4 | Drop camera locations for all survey areas.

4. RESULTS

4.1 Water Quality

Measurements made *insitu* for water samples collected from the Thylacine and Artisan survey areas are presented in Table 5. Dissolved oxygen (DO) and pH were assessed against the default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000). Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types.

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

Table 5 Measurements made *insitu* for water samples at Thylacine and Artisan survey areas.

Sample Name	pH	DO (% saturation)	ORP (mV)
Thylacine_1_1	8.19	94.3	215.0
Thylacine_1_2	8.24	95.2	211.4
Thylacine_1_3	8.33	95.2	98.1
Artisan_1_2	8.16	94.0	172.7
Artisan_2_1	8.08	93.1	211.4
Artisan_5_1	8.34	93.8	164.5

The results of laboratory analyses for water samples from the Thylacine and Artisan survey areas are presented in Tables 6 to 11.

The analytes were compared to the relevant ANZECC (2000) – the default trigger values for physical and chemical stressors for nutrient analytes and the trigger values for toxicants at alternative levels of protection for all other analytes.

The concentration of ammonia, nitrite and reactive phosphorus was at or below LOR for all samples. Only one sample contained a concentration of nitrate-nitrite, NO^{-}_{3}, TKN and TN above the LOR. This was replicate Thylacine_1_3; however, none of the measurements exceeded ANZECC trigger values. Concentrations of TP were recorded in all samples, but all measurements were well below ANZECC trigger values. TSS was typically within the range expected for unmodified[1] marine ecosystems.

The concentrations of Cd, Cr, Co, Pb, Hg, and Ni were at or below LOR in all samples. The concentration of Cu was below, at or very close to the LOR for all samples.

The concentration of Zn against ANZECC protection level (or trigger values) is shown in Figure 5. All concentrations were below the 90% protection level but concentrations variously exceeded 95 or 99% protection levels. This result is consistent with a slightly disturbed marine system which is described in (ANZECC 2000) as an ecosystem in which biodiversity may have been affected to a

[1] Unmodified is a descriptive term used in reference to the quality of the environment and is used in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000). Effectively unmodified ecosystems, typically (but not always) occur in remote and/or inaccessible locations. While there are no aquatic ecosystems in Australia that are entirely without some human influence, the ecological integrity of unmodified ecosystems is regarded as intact.

small degree by human activity. Therefore, this result is likely reflective of the human activities occurring within and around the study area and the levels of environmental Zn are with a reasonable level of species protection for such an environment.

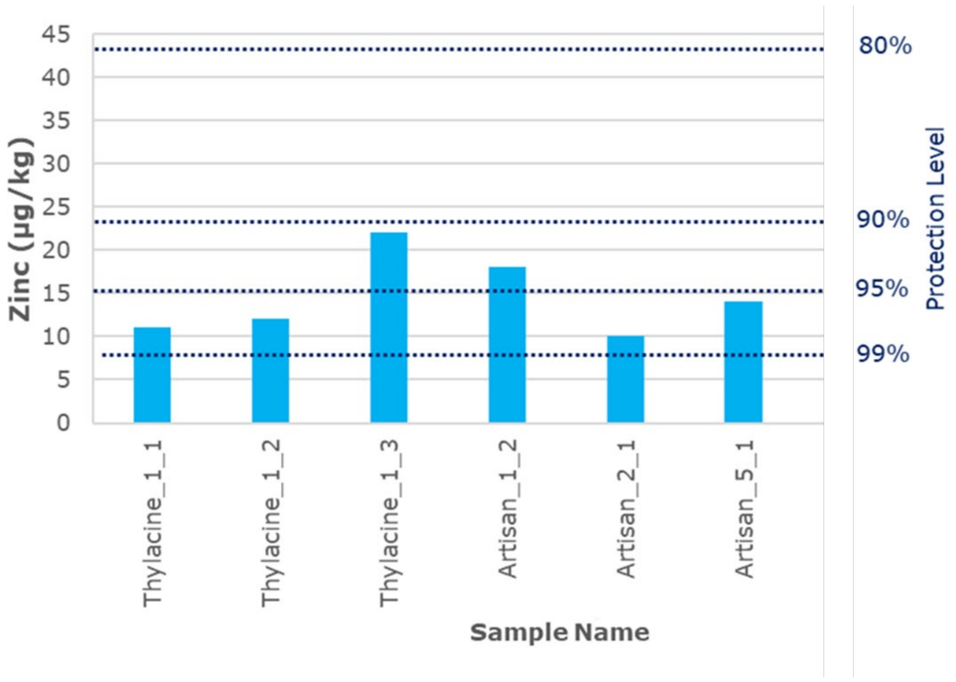


Figure 5 Concentration of Zn in water samples from Thylacine and Artisan survey areas.

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

Table 6 Nutrients in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L								
	NH_3	Nitrate-Nitrite	NO^-_3	Nitrite	TP	RP	TKN	TN	TSS
Thylacine_1_1	< 0.01	< 0.05	0.03	< 0.02	0.03	< 0.01	< 0.2	< 0.2	3.4
Thylacine_1_2	< 0.01	< 0.05	0.02	< 0.02	0.02	< 0.01	< 0.2	< 0.2	9.7
Thylacine_1_3	< 0.01	0.10	0.10	< 0.02	0.02	< 0.01	2.4	2.5	2.4
Artisan_1_2	< 0.01	< 0.05	< 0.02	< 0.02	0.02	< 0.01	< 0.2	< 0.2	5.9
Artisan_2_1	< 0.01	< 0.05	< 0.02	< 0.02	0.01	0.01	< 0.2	< 0.2	4.6
Artisan_5_1	< 0.01	< 0.05	< 0.02	< 0.02	0.01	< 0.01	< 0.2	< 0.2	5.2

Table 7 Metals and metalloids in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L								
	Ar	Cd	Cr	Co	Cu	Pb	Hg	Ni	Zn
Thylacine_1_1	0.001	< 0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	0.011
Thylacine_1_2	0.004	< 0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	0.012
Thylacine_1_3	0.002	< 0.0002	< 0.001	< 0.001	0.002	< 0.001	< 0.0001	0.001	0.022
Artisan_1_2	0.003	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.018
Artisan_2_1	0.005	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.01
Artisan_5_1	0.010	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.014

Table 8 Polycyclic Aromatic Hydrocarbons (PAH) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L					
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Sample Name	mg/L					
	Benzo(g.h.i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene	Fluorene
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Sample Name	mg/L					p-Terphenyl-d14 (%)	2-Fluorobiphenyl (%)
	Indeno(1.2.3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH		
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	134	111
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	145	107
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	138	109
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	93	109
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	102	114
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	101	117

Table 9 Total Recoverable Hydrocarbons (1999 NEPM Fractions) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L				
	TRH C10-C14	TRH C10-C36 (Total)	TRH C15-C28	TRH C29-C36	TRH C6-C9
Thylacine_1_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Thylacine_1_2	0.05	0.15	0.1	< 0.1	< 0.02
Thylacine_1_3	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_1_2	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_2_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_5_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02

Table 10 Total Recoverable Hydrocarbons (2013 NEPM Fractions) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L							
	Naphthalene	TRH >C10-C16	TRH >C10-C16 less Naphthalene (F2)	TRH >C10-C40 (total)*	TRH >C16-C34	TRH >C34-C40	TRH C6-C10	TRH C6-C10 less BTEX (F1)
Thylacine_1_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Thylacine_1_2	< 0.01	0.07	0.07	0.17	0.1	< 0.1	< 0.02	< 0.02
Thylacine_1_3	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_1_2	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_2_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_5_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02

Table 11 BTEX in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L						4-Bromofluoro-benzene (%)
	Benzene	Ethylbenzene	m&p-Xylenes	o-Xylene	Toluene	Xylenes - Total	
Thylacine_1_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	106
Thylacine_1_2	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	94
Thylacine_1_3	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	107
Artisan_1_2	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	94
Artisan_2_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	102
Artisan_5_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	100

4.2 Sediment Quality

The particle size distribution of marine sediments in each sample is shown in Figure 6 with data recorded in Appendix 3. The particle size is <2 µm for the clay-size fraction, 2-20 µm for the silt fraction and 20-2000 µm for the sand fraction. Note that the sample for Artisan 1_1 was a composite of up to three drops of the grab sampler. The sediment within all samples and, therefore at both survey areas, was predominantly sand with a range of 95-97% as a proportion of each sample. There was very little silt and a maximum of 4.7% for the clay-size fraction. There were no discernible trends based on the location of sample collection. The Munsell colour of all samples as 10YR 8/4.

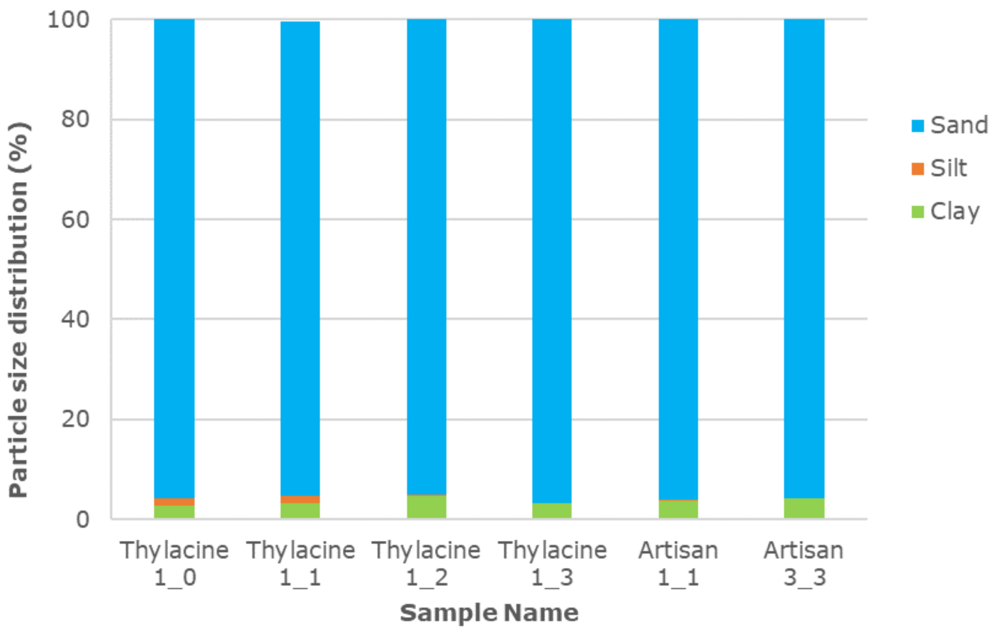


Figure 6 Particle size distribution (%) in sediment samples collected at Thylacine and Artisan survey areas.

The ORP (oxidation-reduction potential) or redox potential of sediments within the samples was measured and the results are presented in Table 12. Note that the measurement probe was inserted into the sediment until resistance prevented further insertion. Given that the substrate was predominantly sand, the probe was typically only inserted to 1-2 cm and no more than 3 cm into the sediment sample. The anoxic layer with low ORP was not detected in any of the sediments analysed and the range of measurements indicated that these sediments maintain a well oxygenated, unmodifed environment.

Table 12 Measurement of oxidation reduction potential in sediment samples at Thylacine and Artisan survey areas.

Sample Name	ORP Measurement Depth (mV)		
	1 cm	2 cm	3 cm
Thylacine_1_0	211	211	No further penetration
Thylacine_1_1	252.7	No further penetration	-
Thylacine_1_2	242.7	No further penetration	-
Thylacine_1_3	225.5	223	216.7
Artisan_1_1	Composite sample; measurement not possible		
Artisan_3_3	242.1	217.3	No further penetration

The results of nutrient analyses are shown in Table 13, Figure 7 and Figure 8. Nitrate-nitrite was not detected in any samples. There was a notable degree of variability in the samples collected in the Thylacine field, however the small number of samples means that a trend or pattern is not discernible. TOC and detectable nitrogen concentrations were slightly higher in the Artisan samples compared to the Thylacine samples. Generally, the concentrations of nutrients in the marine sediments were to be expected for this environment and type of sediment.

Table 13 Nutrients in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg					Total Organic Carbon (%)
	Phosphorus	Silicon	Nitrate-Nitrite	Total Kjeldahl Nitrogen	Total Nitrogen	
Thylacine_1_0	750	850	< 5	230	230	1.3
Thylacine_1_1	620	1000	< 5	190	190	0.9
Thylacine_1_2	400	950	< 5	130	130	0.5
Thylacine_1_3	< 200	460	< 5	180	180	< 0.1
Average (± S.D.)	467.5 (± 284)	815 (± 245)	NA	183 (± 41)	183 (± 41)	1.0 (± 0.5)
Artisan_1_1	620	570	< 5	310	310	1.6
Artisan_3_3	530	810	< 5	270	270	2.4
Average (± S.D.)	575 (± 64)	690 (± 170)	NA	290 (± 28)	290 (± 28)	2.0 (± 1.0)

Level of Reporting (LOR): phosphorus 200 mg/kg; silicon 5 mg/kg; nitrate-nitrite 5 mg/kg; TKN 10 mg/kg; TN 10 mg/kg; TOC 0.1%.
S.D. = standard deviation. Note that average (± S.D.) calculations are made with half LOR where the sample result was < LOR.

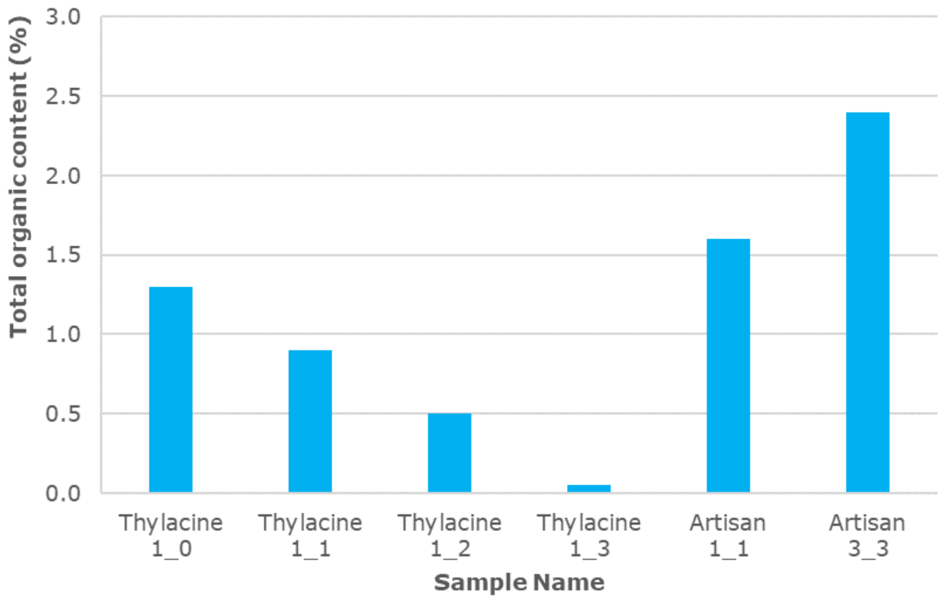


Figure 7 Total organic content (%) in sediment samples collected at Thylacine and Artisan survey areas.

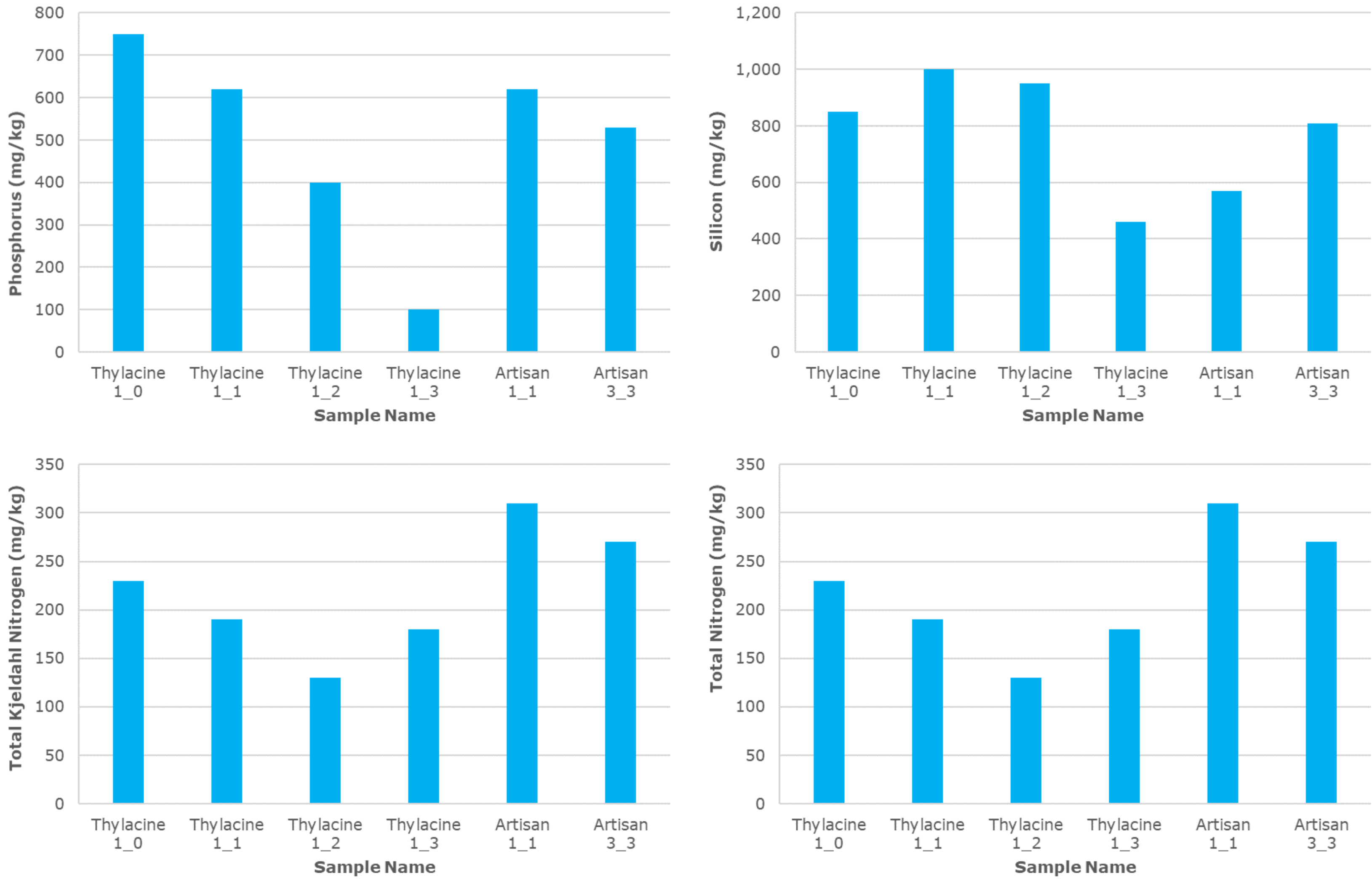


Figure 8 Nutrient concentrations (mg/kg) in sediment samples collected at Thylacine and Artisan survey areas, including phosphorus (top left), silicon (top right), total Kjeldahl nitrogen (bottom left) and total nitrogen (bottom right).

Table 14 presents the results of the analysis for metal compounds in the sediment samples. Of the inorganic compounds tested, Cd, Cu, Pb, Hg, Ni and Sn were below the detection limits (LOR) in all sediment samples. The concentration of Cr in sediments was low, and well below the Interim Sediment Quality Guidelines (ISQG) low trigger value of 80 mg/kg from the recommended sediment quality guidelines set out in ANZECC (2000). The concentration of Cr was slightly higher in the samples from Artisan than those from Thylacine. Zn was detected in two of the six samples (one sample from each field) and was well below the ISQC-Low trigger value of 200 mg/kg.

Table 14 Metals in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg							
	Cd	Cr	Cu	Pb	Hg	Ni	Sn	Zn
Thylacine_1_0	< 0.4	6.2	< 5	< 5	< 0.1	< 5	< 10	7.2
Thylacine_1_1	< 0.4	6.6	< 5	< 5	< 0.1	< 5	< 10	< 5
Thylacine_1_2	< 0.4	6.4	< 5	< 5	< 0.1	< 5	< 10	< 5
Thylacine_1_3	< 0.4	< 5.0	< 5	< 5	< 0.1	< 5	< 10	< 5
Artisan_1_1	< 0.4	11	< 5	< 5	< 0.1	< 5	< 10	9.4
Artisan_3_3	< 0.4	8.1	< 5	< 5	< 0.1	< 5	< 10	< 5

Level of Reporting (LOR): Cd 0.4 mg/kg; Cr 5 mg/kg; Cu 5 mg/kg; Pb 5 mg/kg; Hg 0.1 mg/kg; Ni 5 mg/kg; Sn 10 mg/kg; Zn 5 mg/kg.

The results of laboratory analyses for hydrocarbons in sediment samples from the Thylacine and Artisan survey areas are presented in Tables 15 to 19. BTEXs, PAHs, PCBs and TRHs were either below the LOR or at levels of no concern.

Table 15 Polycyclic Aromatic Hydrocarbons (PAH) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg						
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (lower bound)	Benzo(a)pyrene TEQ (medium bound)
Thylacine_1_0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Artisan_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Artisan_3_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6

Sample Name	mg/kg						
	Benzo(a)pyrene TEQ (upper bound)	Benzo(b&j) fluoranthene	Benzo(g.h.i) perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene
Thylacine_1_0	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_1	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_2	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_3	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Artisan_1_1	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Artisan_3_3	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Name	mg/kg						p-Terphenyl-d14 (%)	2-Fluorobiphenyl (%)
	Fluorene	Indeno(1.2.3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH*		
Thylacine_1_0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	83	79
Thylacine_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	121	92
Thylacine_1_2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	137	87
Thylacine_1_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	118	97
Artisan_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	59	60
Artisan_3_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	147	58

Table 16 Total Recoverable Hydrocarbons (1999 NEPM Fractions) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg				
	TRH C10-C14	TRH C10-C36 (Total)	TRH C15-C28	TRH C29-C36	TRH C6-C9
Thylacine_1_0	< 20	< 50	< 50	< 50	< 20
Thylacine_1_1	< 20	< 50	< 50	< 50	< 20
Thylacine_1_2	< 20	< 50	< 50	< 50	< 20
Thylacine_1_3	< 20	< 50	< 50	< 50	< 20
Artisan_1_1	< 20	< 50	< 50	< 50	< 20
Artisan_3_3	< 20	< 50	< 50	< 50	< 20

Table 17 Total Recoverable Hydrocarbons (2013 NEPM Fractions) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg							
	Naphthalene	TRH >C10-C16	TRH >C10-C16 less Naphthalene (F2)	TRH >C10-C40 (total)*	TRH >C16-C34	TRH >C34-C40	TRH C6-C10	TRH C6-C10 less BTEX (F1)
Thylacine_1_0	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_1	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_2	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_3	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Artisan_1_1	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Artisan_3_3	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20

Table 18 BTEX in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg						4-Bromofluoro-benzene (%)
	Benzene	Ethylbenzene	m&p-Xylenes	o-Xylene	Toluene	Xylenes - Total	
Thylacine_1_0	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	55
Thylacine_1_1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	104
Thylacine_1_2	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	110
Thylacine_1_3	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	106
Artisan_1_1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	62
Artisan_3_3	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	106

Table 19 Polychlorinated Biphenyls in sediment samples at Thylacine and Artisan survey areas

Sample Name	mg/kg								Dibutylchlorendate (%)	Tetrachloro-m-xylene (%)
	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCB*		
Thylacine_1_0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	105	86
Thylacine_1_1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	132	77
Thylacine_1_2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	139	80
Thylacine_1_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	78	77
Artisan_1_1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	73	64
Artisan_3_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	115	54

4.3 Infauna Ecology

The benthic infauna recorded from the grab samples are presented in Table 20. The benthic infauna identified and counted from samples collected at the Thylacine and Artisan sites were relatively depauperate in both abundance and diversity. A total of 22 morpho-species were identified, from a total of 45 organisms collected from the grab samples. The samples Thylacine_1_1 and Artisan_1_4 had the greatest infauna abundance with nine organisms in each sample (Figure 9). The samples Artisan_1_4 and Artisan_3_4 had the greatest diversity with eight morpho-species) (Figure 10), most of which were polychaete worms or crustaceans (Figure 11).

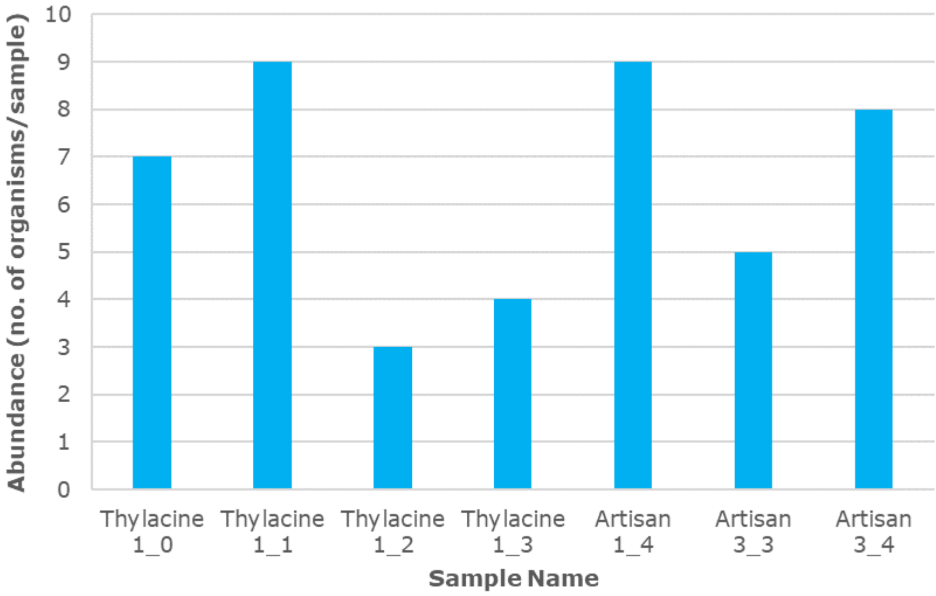


Figure 9 Abundance of benthic infauna in grab samples at Thylacine and Artisan survey areas.

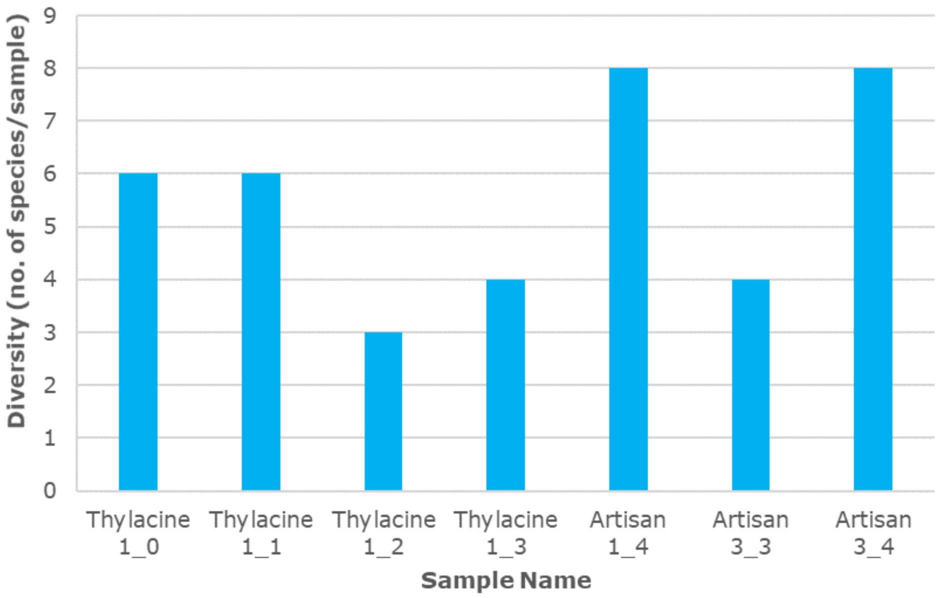


Figure 10 Diversity of benthic infauna in grab samples at Thylacine and Artisan survey areas.

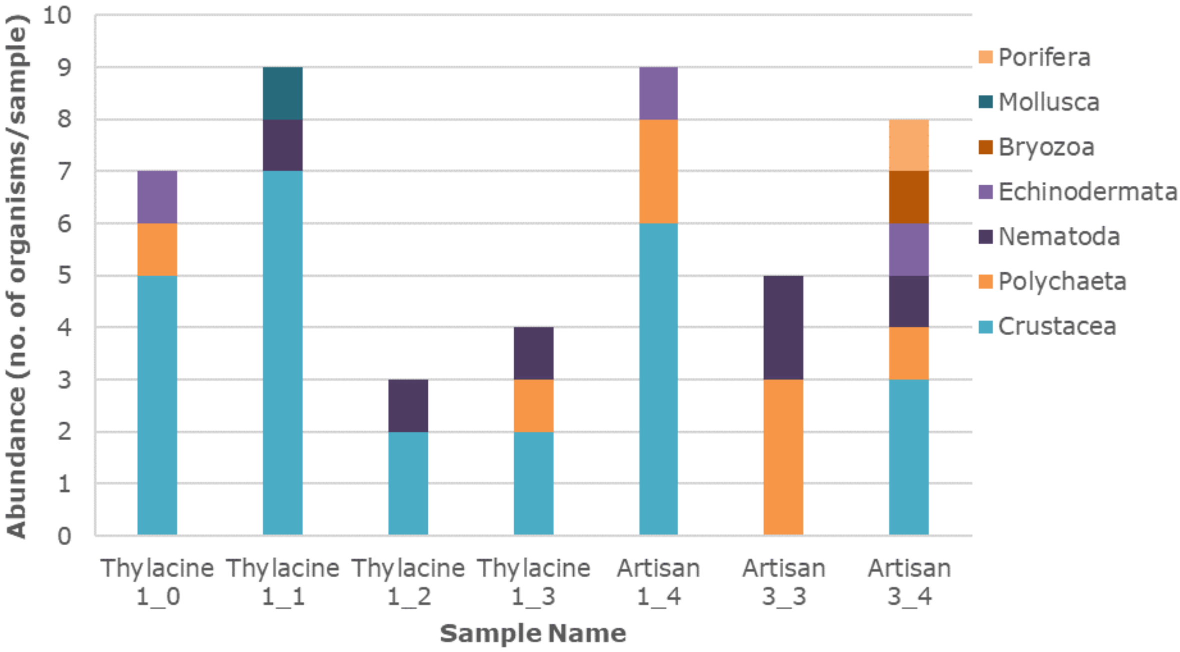


Figure 11 Abundance of benthic infauna by taxonomic group in grab samples at Thylacine and Artisan survey areas.

These results are reflective of the sedimentary environment at the Thylacine and Artisan survey areas, as described in Section 4.2. All sites were dominated by sand, which typically have a lower abundance and diversity of infauna given that this abrasive type of substrate tends to be more easily subjected to hydrodynamic conditions that move the sediment more dynamically than muddy substrates. The consequence of this is a physical environment that is not favourable for filter feeding and burrowing infauna species to inhabit. The observed species typically have a higher tolerance for dynamic environments.

There were no discernible spatial trends in the distribution of sediment particle size. Likewise, there were no clear trends in the abundance, diversity or composition of benthic infauna.

Table 20 Benthic infauna present in sediment samples collected at Thylacine and Artisan survey areas.

Phylum	Class/ Order	Family	Morpho-species	Thylacine				Artisan		
				1_0	1_1	1_2	1_3	1_4	3_3	3_4
Annelida	Polychaeta	Glyceridae	Glyceridae sp.	1			1	1	1	
		Goniadidae	Goniadidae sp.							1
		Pisionidae	Pisionidae sp.					1		
		Spionidae	Spionidae sp.						1	
		Syllidae	Syllidae sp.						1	
Crustacea	Amphipoda	Ampeliscidae	Ampeliscidae sp.		2	1				
		Ischyroceridae	Ischyroceridae sp.					1		1
		Lysianassidae	Lysianassidae sp.	2						
		Oedicerotidae	Oedicerotidae sp.		2					
		Phoxocephalidae	Phoxocephalidae sp.	1			1			
		Platyischnopidae	Platyischnopidae sp.	1		1				1
		Podoceridae	Podoceridae sp.					1		
Crustacea	Caridea	Pasiphaeidae	Pasiphaeidae sp.					1		
	Copepoda	Copepoda	Copepoda sp.					1		
	Cumacea	Bodotriidae	Bodotriidae sp.				1	2		
	Ostracoda	Ostracoda	Ostracoda sp.	1	2					
	Tanaidacea	Tanidae	Tanidae sp.		1					1
Echinodermata	Ophiuroidea	Ophiuroidea	Ophiuroidea sp.	1				1		1
Ectoprocta	Bryozoa	Bryozoa	Branching-sp.2							1
Mollusca	Gastropoda	Rissoidae	Rissoidae sp.		1					
Nematoda	Nematoda	Nematoda	Nematoda		1	1	1		2	1
Porifera	Porifera	Porifera	Solitary-Fan							1

4.4 Epibenthic Ecology

A total of 821 photographs were taken of the seafloor with the survey areas in Otway Basin. A total of 442 photographs used in this assessment (Appendix 5), with the remaining images excluded for the reasons as listed in Section 3.5.2. An average of 56 photographs were taken per survey area, 17 photographs per Hot Tap location and 15 photographs per umbilical route. Table 21 provides a summary of the number of photograph replicate samples used for the visual assessment, average (± standard deviation) for percent cover of epifauna, and total abundance of individual (and often mobile) epifauna organisms. Two example images from each survey area, Hot Tap and umbilical route are included in Appendix 6.

Figure 12 shows the average (± S.D.) percent cover of epifauna at each of the drop camera locations. Percent cover ranged from 0 to 80% of the sample photograph for all samples but on average the percent cover was typically no more than 37% cover. The seabed at Hot Tap X had the greatest average coverage of epibiota while the lowest coverage of epibiota was recorded along the CPT route between Artisan and Hot Tap Y (ARHTY) (Figure 12). Artisan and Hercules survey areas had a slighted greater coverage of epifauna, while the CPT routes between survey areas and Hot Tap Y had the least coverage of epifauna.

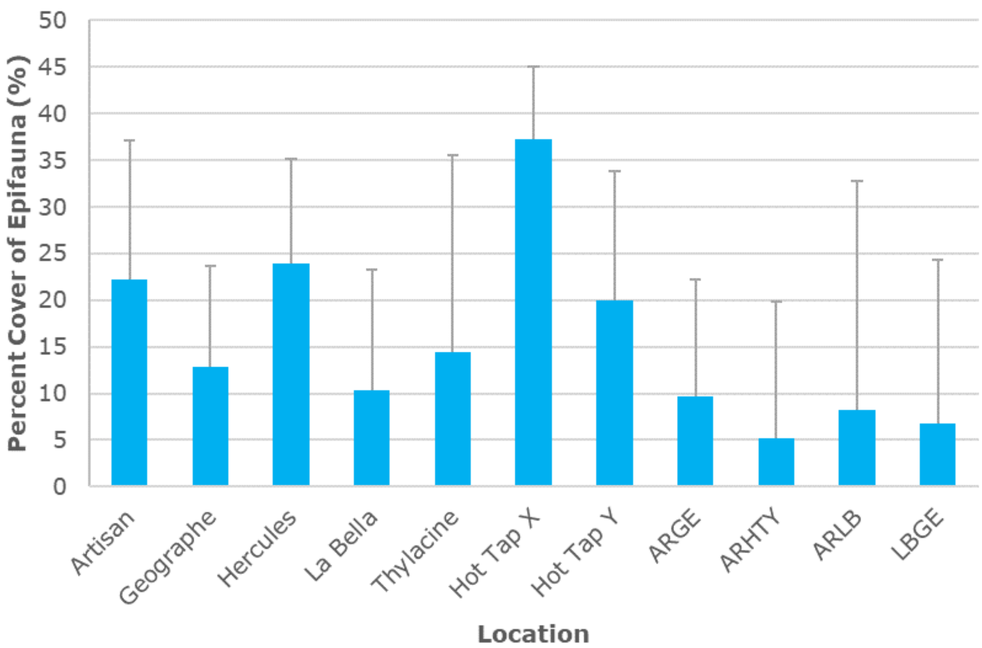


Figure 12 Percent cover of epifauna at drop camera location in Otway Basin.

Figure 13 provides information of the percent cover of epifauna at each drop camera site within these locations and shows the high variability of smaller-scale variability between drop camera sites. For example, the coverage of epifauna at most Thylacine drop camera sites was no more than 16% while at Thylacine 1 the percent cover was up 43% on average.

Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant (Table 21). Figure 14 shows an example of the seabed at Thylacine 1 (TH1) with a high percent cover of epifauna and a relatively high abundance of crinoids. Further examples are included in Appendix 6.

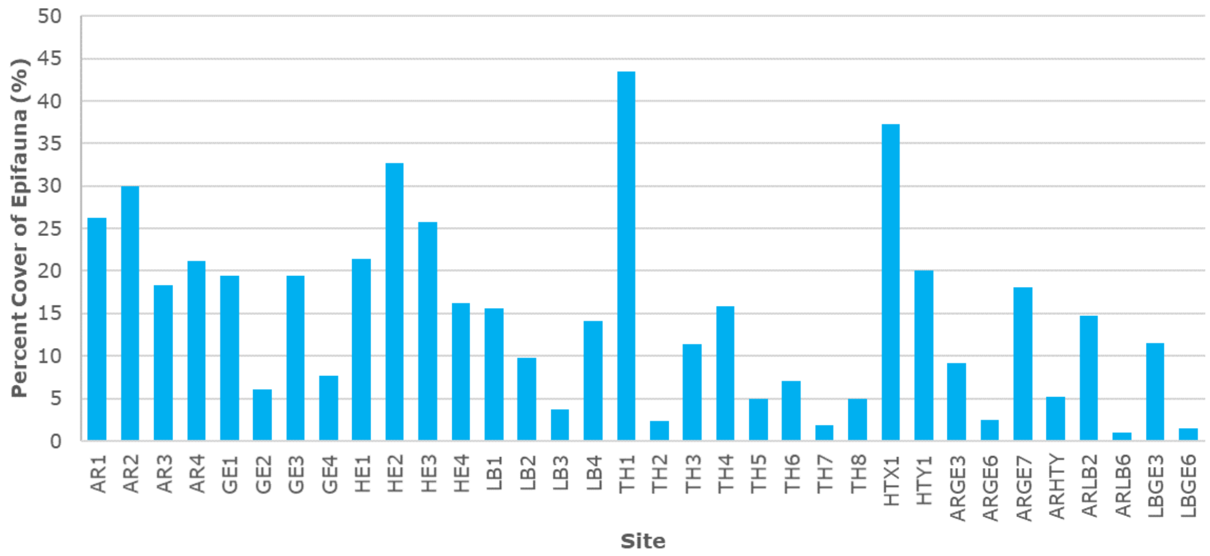


Figure 13 Percent cover of epifauna at drop camera sites in Otway Basin.

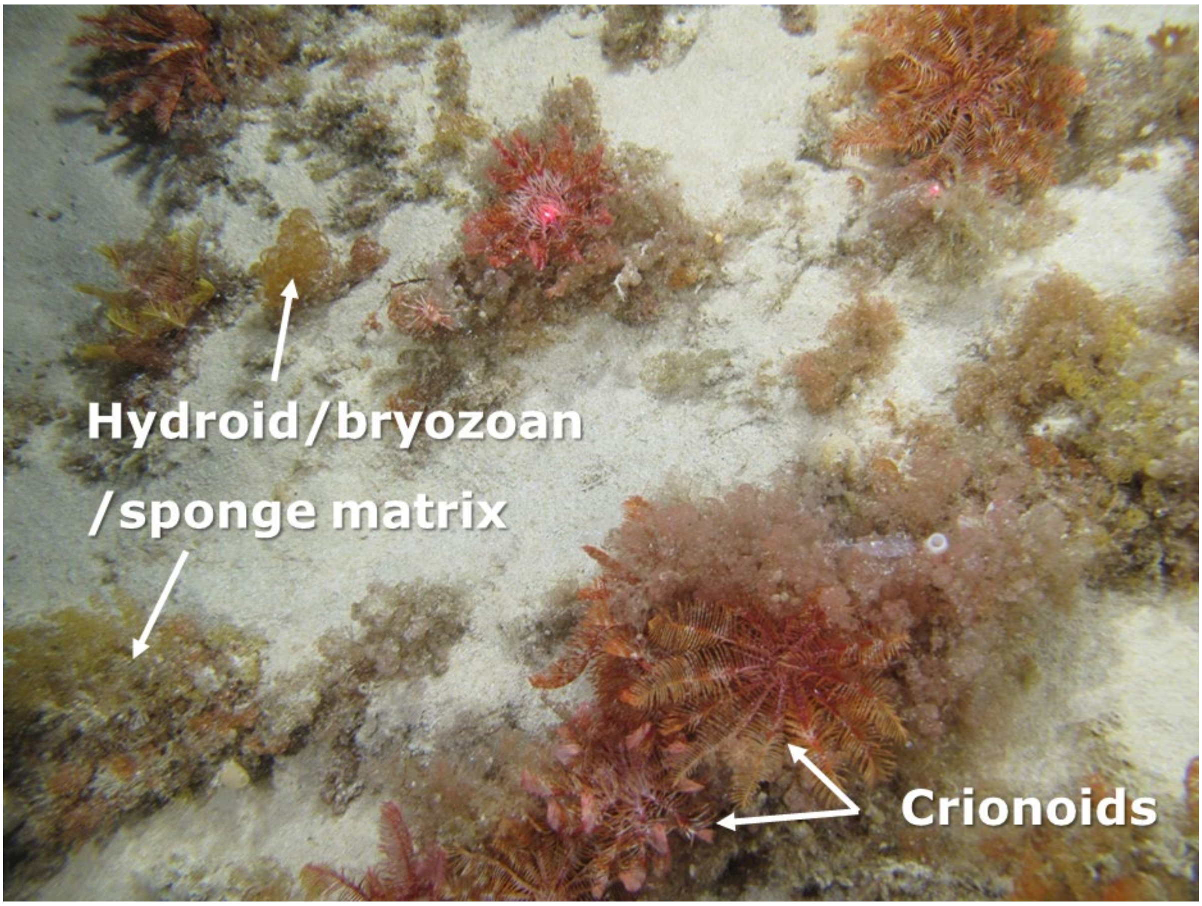


Figure 14 Example of the typical seabed epifauna with high percent cover at Thylacine 1 (TH1).

Table 21 Percent cover and total abundance of epibiota at drop camera sites.

Location	*n*	Percent cover of epifauna (%)		Total abundance of individual organisms								
				Crinoidea	Gastropoda spp.					Nudibranchia	Polychaeta	Teleostei
		Average	S.D.		Sp. 1	Sp. 2	Sp. 3	Sp. 4	Sp. 5			
AR1	4	26	15			4						
AR2	4	30	11			1						
AR3	9	18	11			1						
AR4	13	21	13			14						
GE1	9	19	21		2	2						
GE2	9	6	8		1							
GE3	9	19	14			1						
GE4	11	8	13			1						
HE1	14	21	15					2				
HE2	15	33	24		1	1		1				
HE3	14	26	18	1		2	1					
HE4	16	16	12		1							
LB1	9	16	10			1						
LB2	18	10	10									
LB3	15	4	2			4						
LB4	17	14	15			2		1				
TH1	16	43	14	40						1		
TH2	15	2	3		1	1						
TH3	21	11	7	8		7			2			
TH4	18	16	8	24								

Location	*n*	Percent cover of epifauna (%)		Total abundance of individual organisms								
		Average	S.D.	Crinoidea	Gastropoda spp. Sp. 1	Gastropoda spp. Sp. 2	Gastropoda spp. Sp. 3	Gastropoda spp. Sp. 4	Gastropoda spp. Sp. 5	Nudibranchia	Polychaeta	Teleostei
TH5	1	5	-									
TH6	5	7	4									
TH7	8	2	3			1						
TH8	11	5	2			1						
HTX1	9	37	14		2	1		1				
HTY1	18	20	8			7		1	1			
ARGE3	12	9	8			6	1				1	
ARGE6	20	3	3			1						1
ARGE7	18	18	10			3		1				1
ARHTY	21	5	11	1	1	1				1		1
ARLB2	17	15	9			5	1					
ARLB6	15	1	2			7		1				
LBGE3	16	12	17			4						
LBGE6	14	1	2			1		1				

A composite, qualitative sample of epifauna from the Artisan field as examined and identified by the Benthic Australia invertebrate laboratory, with the results presented in Table 22. This epifauna was collected from grab samples at Artisan 1. This analysis shows that much of the epifauna is comprised of branching bryozoans, feather-like gorgonian cnidarians and sponges. This complex of encrusting/branching fauna provides refuge for macrofauna such as amphipods, isopods, polychaete worms and molluscs.

Table 22 Epifauna present in grab samples collected at the Artisan field.

Phylum	Class/ Order	Family	Morpho-species	Artisan_1_Epifauna
Annelida	Polychaeta	Amphinomidae	Hermodice spp.	1
		Eunicidae	Eunice spp.	1
		Phyllodocidae	Phyllodocidae sp.	1
		Syllidae	Syllidae sp.	2
		Terebellidae	Terebellidae sp.	1
Cnidaria	Alcyonacea	Alcyonacea	Gorgonian-Feather sp.	1
Crustacea	Amphipoda	Dexaminidae	Dexaminidae sp.	10
		Eusiridae	Eusiridae sp.	2
		Ischyroceridae	Ischyroceridae sp.	2
		Maeridae	Maeridae sp.1	3
			Maeridae sp.2	3
		Stegocephalidae	Stegocephalidae sp.	2
Crustacea	Isopoda	Valvifera	Valvifera sp.	1
Echinodermata	Ophiuroidea	Ophiuroidea	Ophiuroidea sp.	4
Ectoprocta	Bryozoa	Bryozoa	Branching-sp.1	7
			Branching-sp.2	2
Mollusca	Bivalvia	Glycymerididae	Glycymerididae sp.	1
	Gastropoda	c.f.Olividae	c.f.Olividae sp.	1
Porifera	Porifera	Porifera	Conglomerate-Branching sp.	3
			Conglomerate-Bulbous sp.1	4
			Conglomerate-Bulbous sp.2	2
			Solitary-Fan	4

5. DISCUSSION

The survey was conducted over in the Otway Basin covering five survey areas, two hot taps and five routes between those locations. The survey areas were located in offshore Commonwealth waters at 32 to 80 km from Port Campbell. Water depth ranged from 70 to 104 m.

The water quality at the Thylacine and Artisan survey areas indicated an undisturbed mid-depth environment, based on the six samples collected during the survey. There were low or undetectable levels of nutrients, metals/metalloids, BTEXs, PAHs and TRHs in the seawater samples. Metal and metalloids measurements were generally below ANZECC trigger values and within the range expected for unmodified, marine waters. The range of ORP measurements indicated a well oxygenated, ecologically healthy environment.

The sandy substrates described for Thylacine and Artisan survey areas are consistent with the reported description for the area of unconsolidated seabed sediments made up of carbonate sands (Barton et al., 2012; Murray-Wallace and Woodroffe, 2014). The sediment quality results were also consistent with Jones and Davies (1983) who described the grain size distribution as sand and gravel covering the entire shelf except for areas of silty sand in central Bass Strait and other locations more remote from the survey area. The authors noted a regional trend of ‘reverse grading’ whereby sediment tended to become coarser with distance from shore. Fine sand was reported to be the predominant sediment type along the inner shelf of Victoria and off much of Tasmania, grading seawards into medium-grain sand, and locally into coarse sand at the edge of the shelf (Jones and Davies, 1983). While the gravel fraction was not assessed, it is likely that some gravel occurs within the sediment as shown by some larger shell fragments observed in seabed photographs. Sediments had a high ORP and low or undetectable levels of toxicants indicating an unmodified seabed environment.

The Otway Basin is part of the Southeast Marine Bioregion which extends from the far south coast of New South Wales to Kangaroo Island (Commonwealth of Australia, 2015). Significant variation in seafloor features and water depth contribute to the high level of species diversity in the Region and the shelf habitats are reported to support a diverse range of species from a broad range of taxonomic groups (Commonwealth of Australia, 2015). However, there is no readily-available literature describing the seabed fauna of Otway Basin, meaning it is not possible to make a comparison of infauna and epifauna communities detected to prior studies. Most descriptions of the ecological values of the Basin or the Bioregion are at a broad scale and focus of key features such as cetaceans, birds, fisheries and macroalgae habitats (Commonwealth of Australia, 2015).

Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of a unmodifed marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2.

A microscopic examination of a qualitative sample of this epibiota indicated that this complex of fauna provide microhabitat for a range of macrofauna such as amphipods, isopods, polychaete worms and molluscs. Such epifaunal habitats are known to provide refuge and other resources for benthic species (Jones, 2006). By comparison, there was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.

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

6. REFERENCES

Barton, J.; Pope, A.; Howe S. (2012) Marine Natural Values Study Vol 2: Marine Protected Areas of the Otway Bioregion. Parks Victoria Technical series No. 75. Parks Victoria, Melbourne.

Commonwealth of Australia (2015) South-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region. 87 p. https://www.environment.gov.au/system/files/resources/7a110303-f9c7-44e4-b337-00cb2e4b9fbf/files/south-east-marine-region-profile.pdf [Accessed February 2020].

Jones, E.J. (2006) Bryozoan thickets on Otago shelf, New Zealand: a quantitative assessment of the epibenthos using underwater photography. MSc thesis. University of Otago, Dunedin, New Zealand. 213 p.

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Murray-Wallace, C.V.; Woodroffe, C.D. (2014) Quaternary sea-level changes: a global perspective. Cambridge University Press, Cambridge 484 p.

APPENDIX 1
ENVIRONMENTAL SAMPLE LOGS

SAMPLE MANAGEMENT ROUTINES

Project Code: 318000803	**Project Name: Otway Offshore Development**	
Vessel: Vos Shine **Location: Artisan and Thylacine, Otway Basin**	**Sampling Team: Irene Middleton** **Sampling Gear: Van Dorn 2.4L and Van Veen Double benthic grab sampler**	**Date: 22/11/2019**

☑	**All samples are stored on board as required for the analysis**	
☒	**Once ashore samples are transported by air with the sampling team to Perth**	**Not required, samples sent directly from port to lab.**
☑	**All Chain of Costody (COC) forms are copied and saved to cloud storage prior to sample dispatch**	
☑	**Samples for contaminants analyses (metals, metalloids, hydrocarbons) are shipped by courier to EUROFINS in Melbourne with COC documentation**	
☑	**Samples for infaunal analysis are shipped via courier to Benthic Australia, Gladstone, QLD with COC documentation**	
☑	**Image data is saved in its entireity to two separate storage drives, each transported by a different team member to Ramboll's office (holding a relevant COC)**	**Only one team member transported storage drives as only one enviro team member on board at one time. Additional image data sent to Ramboll by Fugro via sercure file transfer.**
☑	**Image data is saved in its entireity to Ramboll's secure servers once back in the office (noted on COC when complete)**	

Comments:

SAMPLING LOG

Project Code: 318000803						Project Name: Otway Offshore Development					
Vessel: VOS Shine					Sampling Team: Irene Middleton			Sky/Wind: 20 knots		Date: 22/11/2019	
Location: Artisan					Sampling Gear: Van Dorn 2.4L water sampler			Sea State: 2 m swell		Shift: 04:00-20:00	
Site No.	**Local Time**	**Sample No.**	**Replicate No.**	**Image ID**	**Sample Acceptable?**	**pH**	**ORP (mV)**	**Temperature (°C)**	**Dissolved oxygen (%/ppb)**	**Conductivity (uS/cm)**	**Visual Contamination**
AR 2	6:21	2	1	N/A	YES, Sampler A	8.08	172.1	13.6	93.1/7.78	497679	None
AR 1a	6:49	1	1	N/A	NO, sample rejected	-	-	-	-	-	-
AR 1b	7:11	1	2	N/A	YES, Sampler A	8.16	172.7	13.9	93.8/7.89	50112	None
AR 5	7:26	1	1	N/A	YES, Sampler A	8.34	164.5	13.4	93.8/7.89	50502	None

Comments: Sampler B was contaminated by a greasy hand print so all samples came from Sampler A. Blank samples were collected from Sampler A (labelled Blank A) and Sampler B (labelled Blank B).

SAMPLING LOG

Project Code: 318000803	**Project Name: Otway Offshore Development**		
Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Artisan	**Sampling Gear: Van Veen Double benthic grab sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	Local Time	Sample No.	Replicate No.	Image ID	Sample Acceptable?	Munsell Colour	ORP (mV)	Texture / Surface or Vertical Structure	Odour (describe)	Visual Contamination	Organic Fragments /Bioturbation /other Fauna
AR_GS-1	8:36	1	1	1-5	NO, not enough material	7.5YR 8/4	-	Sand and epibenthos/sponges	None	None	Sponges, bryozoans, ascidians
AR_GS-1	9:12	1	2	-	NO, grab not triggered	-	-	-	-	-	-
AR_GS-1	9:40	1	3	6-10	YES, small sample used for composite sample	10YR 8/4	Not able to be measured for small sample	Sand, some sponge	None	None	Sponge, coral fragments and tubeworms
AR_GS-1	10:05	1	4	11-13	YES, small sample (3 cm deep) used for composite sample	10YR 8/4	176.4 at 2 cm	Sand	None	None	No sponges, just shell
AR_GS-1	10:39	1	5	14-15	NO	-	-	Only some epifauna retained for examination	None	None	Sponges and bryozoans
AR_GS-1	10:56	1	6	16-19	YES, small sample used for composite sediment sample, no infauna sampled	10YR 8/4	176.3 at 1 cm	Sand	None	None	Bryozoans and corals
AR4_GS-3_1	12:25	3	1	-	NO, grab not triggered	-	-	-	-	-	-
AR4_GS-3_2	12:45	3	2	20-21	NO, small sample (3 cm deep) for sediment only. Infauna grab not triggered	10YR 8/4	217.3 at 2 cm	Shelly sand	None	None	-

AR4_GS-3_3	13:20	3	3	22-24	YES, good sample	10YR 8/4	241.2 at 1 cm	Shelly sand	None	None	-
AR4_GS-3_4	13:30	3	4	25-26	YES, infauna only, 7 cm deep	10YR 8/4	202.3 at 1 cm	Shell coarse hash	None	None	None

Comments: Sample quality was variable and did not always meet the acceptability criteria but allowances were made to get some material for processing.

SAMPLING LOG

Project Code: 318000803	**Project Name: Otway Offshore Development**		
Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Thylacine	**Sampling Gear: Van Veen Double benthic grab sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	Local Time	Sample No.	Replicate No.	Image ID	Sample Acceptable?	Munsell Colour	ORP (mV)	Texture / Surface or Vertical Structure	Odour (describe)	Visual Contamination	Organic Fragments /Bioturbation /other Fauna
TH_GS1	17:12	1	0	27-30	YES, 15 cm deep	10YR 8/4	216.7 at 3 cm	Shelly and	None	None	Shell coarse, sand
TH_GS1_1	17:42	1	1	31-33	YES	10YR 8/4	211.0 at 2 cm	Shelly sand	None	None	Shell coarse, sand
TH_GS1_2	18:04	1	2	34-36	YES	10YR 8/4	252.7 at 1 cm	Shelly sand	None	None	Shell coarse, sand
TH_GS1_3	18:26	1	3	37-40	YES	10YR 8/4	242.7 at 1cm	Shelly sand	None	None	Shell coarse, sand

Comments:

SAMPLING LOG

Project Code: 318000803		**Project Name: Otway Offshore Development**	
Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Artisan and Thylacine	**Sampling Gear: Van Dorn 2.4L water sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	Local Time	Sample No.	Replicate No.	Image ID	Sample Acceptable?	pH	ORP (mV)	Temperature (°C)	Dissolved oxygen (%/ppb)	Conductivity (uS/cm)	Visual Contamination
TH_GS1	19:13	1	1	N/A	YES, Sampler A	8.19	215	13.4	94.3/8.07	No clear/steady reading	None
TH_GS1	19:30	1	2	N/A	YES, Sampler A	8.24	211.4	13.2	95.2/8.33	No clear/steady reading	None
TH_GS1	19:40	1	3	N/A	YES, Sampler A	8.33	198.1	13.2	95.2/8.16	No clear/steady reading	None

Comments:

SAMPLING LOG _REDOX MEASUREMENTS

Project Code: 318000803 | **Project Name: Otway Offshore Development**

Recorder: Irene Middleton | **Sample Acceptable: Only acceptable samples used** | **Date: 22/11/2019** | **Time (local): 0400-2000**

ORP Reading Depth (mm)

Site No.	Sample No.	Replicate No.	Surface	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Artisan GS	1	4	No surface measurements as hard sand surface gave indeterminate readings	176.2	176.4	No further penetration															
Artisan GS	1	6		176.3	No further penetration																
Artisan GS 3	2	1	As above	242.1	217.3	No further penetration															
Artisan GS 3	2	2	As above	241.2	No further penetration																
Artisan GS 3	2	3	As above	202.3	No further penetration																
Thylacine GS 2	1	1	As above	225.5	223.0	216.7	No further penetration														
Thylacine GS 1	1	1	As above	211.0	211.0	No further penetration															
Thylacine GS 1	1	1	As above	252.7	No further penetration																
Thylacine GS 1	1	1	As above	242.7	No further penetration																

Comments:

APPENDIX 2
WATER QUALITY LABORATORY REPORT

eurofins | Environment Testing

Certificate of Analysis

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention:	**Dan McClary**
Report	**690395-W**
Project name	OTWAY OFFSHORE EBS
Project ID	318000803
Received Date	Dec 04, 2019

Client Sample ID			**THYLACINE_GS1_1**	**THYLACINE_GS1_2**	**THYLACINE_G1_3**	**ARTISON_1**
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**M19-No38322**	**M19-No38323**	**M19-No38324**	**M19-No38325**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1	0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1	0.15	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	106	94	107	94
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	0.07	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	0.07	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1	0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1	0.17	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001

Client Sample ID			THYLACINE_GS1_1	THYLACINE_GS1_2	THYLACINE_G1_3	ARTISON_1
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			M19-No38322	M19-No38323	M19-No38324	M19-No38325
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	111	107	109	109
p-Terphenyl-d14 (surr.)	1	%	134	145	138	93
Ammonia (as N)	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Chlorophyll a	5	ug/L	< 10	< 10	< 10	< 10
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	0.10	< 0.05
Nitrate (as N)	0.02	mg/L	0.03	0.02	0.10	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Phosphate total (as P)	0.01	mg/L	0.03	0.02	0.02	0.02
Phosphorus reactive (as P)	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	2.4	< 0.2
Total Nitrogen (as N)*	0.2	mg/L	< 0.2	< 0.2	2.5	< 0.2
Total Suspended Solids Dried at 103–105°C	1	mg/L	3.4	9.7	2.4	5.9
Heavy Metals						
Arsenic	0.001	mg/L	0.001	0.004	0.002	0.003
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Copper	0.001	mg/L	< 0.001	< 0.001	0.002	0.001
Lead	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	< 0.001	< 0.001	0.001	< 0.001
Zinc	0.005	mg/L	0.011	0.012	0.022	0.018

Client Sample ID			ARTISON_2	ARTISON_5	BLANK A	BLANK B
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			M19-No38326	M19-No38327	M19-No38328	M19-No38329
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	0.003	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	102	100	96	92

Client Sample ID			ARTISON_2	ARTISON_5	BLANK A	BLANK B
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			M19-No38326	M19-No38327	M19-No38328	M19-No38329
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	114	117	97	56
p-Terphenyl-d14 (surr.)	1	%	102	101	52	67
Ammonia (as N)	0.01	mg/L	< 0.01	< 0.01	0.03	< 0.01
Chlorophyll a	5	ug/L	< 10	< 10	-	-
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Phosphate total (as P)	0.01	mg/L	0.01	0.01	< 0.01	< 0.01
Phosphorus reactive (as P)	0.01	mg/L	0.01	< 0.01	< 0.01	< 0.01
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	< 0.2	< 0.2
Total Nitrogen (as N)*	0.2	mg/L	< 0.2	< 0.2	< 0.2	< 0.2
Total Suspended Solids Dried at 103–105°C	1	mg/L	4.6	5.2	< 1	3.1
Heavy Metals						
Arsenic	0.001	mg/L	0.005	0.010	0.001	0.001
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Copper	0.001	mg/L	0.001	0.001	< 0.001	0.040
Lead	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Zinc	0.005	mg/L	0.010	0.014	0.021	0.032

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins | mgt Suite B4			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Melbourne	Dec 06, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Dec 06, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Dec 09, 2019	
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P			
Ammonia (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4200 Ammonia by Discrete Analyser			
Nitrate & Nitrite (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrate (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrite (as N)	Melbourne	Dec 09, 2019	2 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Phosphate total (as P)	Melbourne	Dec 09, 2019	28 Days
- Method: APHA 4500-P E. Phosphorus			
Phosphorus reactive (as P)	Melbourne	Dec 09, 2019	2 Days
- Method: APHA 4500-P			
Total Kjeldahl Nitrogen (as N)	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-INO-4310 TKN in Waters & Soils by FIA			
Chlorophyll a	Melbourne	Dec 06, 2019	2 Days
- Method: LTM-INO-4340 Chlorophyll a in Waters			
Total Suspended Solids Dried at 103–105°C	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry			
Heavy Metals	Sydney	Dec 11, 2019	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

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Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 690395
Phone: 08 9225 5199
Fax:

Received: Dec 4, 2019 10:56 AM
Due: Dec 11, 2019
Priority: 5 Day
Contact Name: ALL INVOICES

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Arsenic	Cadmium	Chlorophyll a	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Pheophytin*	Total Suspended Solids Dried at 103–105°C	Zinc	Eurofins | mgt Suite B4	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P
Melbourne Laboratory - NATA Site # 1254 & 14271								X							X	X		X	X
Sydney Laboratory - NATA Site # 18217 & 14271						X	X		X	X	X	X	X	X			X		
Brisbane Laboratory - NATA Site # 20794 & 14271																			
Perth Laboratory - NATA Site # 23736 & 14271																			
External Laboratory																			
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**														
1	THYLACINE_GS1_1	Nov 22, 2019		Water	M19-No38322	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_GS1_2	Nov 22, 2019		Water	M19-No38323	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_G1_3	Nov 22, 2019		Water	M19-No38324	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	ARTISON_1	Nov 22, 2019		Water	M19-No38325	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	ARTISON_2	Nov 22, 2019		Water	M19-No38326	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	ARTISON_5	Nov 22, 2019		Water	M19-No38327	X	X	X	X	X	X	X	X	X		X	X	X	X
7	BLANK A	Nov 22, 2019		Water	M19-No38328	X	X	X	X	X	X	X	X	X		X	X	X	X
8	BLANK B	Nov 22, 2019		Water	M19-No38329	X	X	X	X	X	X	X	X	X		X	X	X	X

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Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Dec 4, 2019 10:56 AM
Address:	Suite 3, Level 2, 200 Adelaide Terrace	**Report #:**	690395	**Due:**	Dec 11, 2019
	East Perth	**Phone:**	08 9225 5199	**Priority:**	5 Day
	WA 6004	**Fax:**		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail	Arsenic	Cadmium	Chlorophyll a	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Pheophytin*	Total Suspended Solids Dried at 103–105°C	Zinc	Eurofins | mgt Suite B4	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P
Melbourne Laboratory - NATA Site # 1254 & 14271			X							X	X		X	X
Sydney Laboratory - NATA Site # 18217 & 14271	X	X		X	X	X	X	X	X			X		
Brisbane Laboratory - NATA Site # 20794 & 14271														
Perth Laboratory - NATA Site # 23736 & 14271														
Test Counts	8	8	8	8	8	8	8	8	8	5	8	8	8	8

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g.h.i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a.h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1.2.3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Nitrate & Nitrite (as N)	mg/L	< 0.05			0.05	Pass	
Nitrate (as N)	mg/L	< 0.02			0.02	Pass	
Nitrite (as N)	mg/L	< 0.02			0.02	Pass	
Phosphate total (as P)	mg/L	< 0.01			0.01	Pass	
Phosphorus reactive (as P)	mg/L	< 0.01			0.01	Pass	
Total Kjeldahl Nitrogen (as N)	mg/L	< 0.2			0.2	Pass	
Total Suspended Solids Dried at 103–105°C	mg/L	< 1			1	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/L	< 0.001			0.001	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	

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Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium	mg/L	< 0.001			0.001	Pass	
Cobalt	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	< 0.001			0.001	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Mercury	mg/L	< 0.0001			0.0001	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Zinc	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	94			70-130	Pass	
TRH C10-C14	%	115			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	92			70-130	Pass	
Toluene	%	79			70-130	Pass	
Ethylbenzene	%	83			70-130	Pass	
m&p-Xylenes	%	76			70-130	Pass	
Xylenes - Total	%	78			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	77			70-130	Pass	
TRH C6-C10	%	94			70-130	Pass	
TRH >C10-C16	%	107			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	87			70-130	Pass	
Acenaphthylene	%	85			70-130	Pass	
Anthracene	%	72			70-130	Pass	
Benz(a)anthracene	%	99			70-130	Pass	
Benzo(a)pyrene	%	72			70-130	Pass	
Benzo(b&j)fluoranthene	%	72			70-130	Pass	
Benzo(g.h.i)perylene	%	75			70-130	Pass	
Benzo(k)fluoranthene	%	98			70-130	Pass	
Chrysene	%	99			70-130	Pass	
Dibenz(a.h)anthracene	%	80			70-130	Pass	
Fluoranthene	%	85			70-130	Pass	
Fluorene	%	100			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	98			70-130	Pass	
Naphthalene	%	86			70-130	Pass	
Phenanthrene	%	95			70-130	Pass	
Pyrene	%	86			70-130	Pass	
LCS - % Recovery							
Ammonia (as N)	%	100			70-130	Pass	
Nitrate & Nitrite (as N)	%	101			70-130	Pass	
Nitrate (as N)	%	101			70-130	Pass	
Nitrite (as N)	%	106			70-130	Pass	
Phosphate total (as P)	%	95			70-130	Pass	
Phosphorus reactive (as P)	%	95			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	%	84			70-130	Pass	
Total Suspended Solids Dried at 103–105°C	%	98			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	90			70-130	Pass	
Cadmium	%	92			70-130	Pass	

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Environment Testing

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium			%	98			70-130	Pass	
Cobalt			%	100			70-130	Pass	
Copper			%	100			70-130	Pass	
Lead			%	101			70-130	Pass	
Mercury			%	96			70-130	Pass	
Nickel			%	99			70-130	Pass	
Zinc			%	98			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	M19-De05914	NCP	%	111			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	M19-De05914	NCP	%	104			70-130	Pass	
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrate & Nitrite (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrate (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrite (as N)	B19-De03253	NCP	%	106			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	N19-De04634	NCP	%	91			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	M19-No38324	CP	%	84			70-130	Pass	
Acenaphthylene	M19-No38324	CP	%	85			70-130	Pass	
Anthracene	M19-No38324	CP	%	74			70-130	Pass	
Benz(a)anthracene	M19-No38324	CP	%	72			70-130	Pass	
Benzo(a)pyrene	M19-No38324	CP	%	82			70-130	Pass	
Benzo(b&j)fluoranthene	M19-No38324	CP	%	79			70-130	Pass	
Benzo(g.h.i)perylene	M19-No38324	CP	%	89			70-130	Pass	
Benzo(k)fluoranthene	M19-No38324	CP	%	113			70-130	Pass	
Chrysene	M19-No38324	CP	%	106			70-130	Pass	
Dibenz(a.h)anthracene	M19-No38324	CP	%	83			70-130	Pass	
Fluoranthene	M19-No38324	CP	%	89			70-130	Pass	
Fluorene	M19-No38324	CP	%	101			70-130	Pass	
Indeno(1.2.3-cd)pyrene	M19-No38324	CP	%	82			70-130	Pass	
Naphthalene	M19-No38324	CP	%	81			70-130	Pass	
Phenanthrene	M19-No38324	CP	%	93			70-130	Pass	
Pyrene	M19-No38324	CP	%	94			70-130	Pass	
Spike - % Recovery									
				Result 1					
Phosphate total (as P)	M19-No38324	CP	%	92			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	M19-No38329	CP	%	95			70-130	Pass	
Cadmium	M19-No38329	CP	%	94			70-130	Pass	
Chromium	M19-No38329	CP	%	87			70-130	Pass	
Cobalt	M19-No38329	CP	%	88			70-130	Pass	
Copper	M19-No38329	CP	%	84			70-130	Pass	
Lead	M19-No38329	CP	%	90			70-130	Pass	
Mercury	M19-No38329	CP	%	80			70-130	Pass	
Nickel	M19-No38329	CP	%	85			70-130	Pass	
Zinc	M19-No38329	CP	%	88			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	B19-De02116	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C10-C14	M19-De05913	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	M19-De05913	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	M19-De05913	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	B19-De02116	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total	B19-De02116	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	B19-De02116	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
TRH C6-C10	B19-De02116	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH >C10-C16	M19-De05913	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	M19-De05913	NCP	mg/L	< 0.1		<1	30%	Pass	
TRH >C34-C40	M19-De05913	NCP	mg/L	< 0.1		<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	B19-De03253	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Chlorophyll a	M19-De06051	NCP	ug/L	28	34	21	30%	Pass	
Nitrate & Nitrite (as N)	B19-De03253	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Nitrate (as N)	B19-De03253	NCP	mg/L	0.04	0.05	34	30%	Fail	Q15
Nitrite (as N)	B19-De03253	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Phosphate total (as P)	M19-De05566	NCP	mg/L	0.91	0.88	4.0	30%	Pass	
Total Kjeldahl Nitrogen (as N)	M19-De03633	NCP	mg/L	79	77	2.8	30%	Pass	
Total Suspended Solids Dried at 103–105°C	M19-De06128	NCP	mg/L	230	230	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M19-No38322	CP	mg/L	0.001	0.001	2.0	30%	Pass	
Cadmium	M19-No38322	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury	M19-No38322	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc	M19-No38322	CP	mg/L	0.011	0.012	9.0	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Acenaphthylene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benz(a)anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(a)pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(b&j)fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(g.h.i)perylene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(k)fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chrysene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Dibenz(a.h)anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluorene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Naphthalene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Phenanthrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Robert Johnston	Analytical Services Manager
Gabriele Cordero	Senior Analyst-Metal (NSW)
Harry Bacalis	Senior Analyst-Volatile (VIC)
Joseph Edouard	Senior Analyst-Organic (VIC)
Julie Kay	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Environment Testing

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Attention: **Dan McClary**

Report **690387-A**
Project name OTWAY OFFSHORE EBS
Project ID 318000803
Received Date Dec 04, 2019

Client Sample ID			**ARTISON-1**	**ARTISON-5**	**ARTISON-2**	**THYLACINE GS1_3**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**M19-No38257**	**M19-No38258**	**M19-No38259**	**M19-No38260**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Chlorophyll a	10	ug/L	< 10	< 10	< 10	< 10

Client Sample ID			**THYLACINE GS1_1**	**THYLACINE GS1_2**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**M19-No38261**	**M19-No38262**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit		
Chlorophyll a	10	ug/L	< 10	< 10

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chlorophyll a	Melbourne	Nov 27, 2019	2 Days
- Method:			

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Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
External Laboratory																					
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																
1	THYLACINE_ GS1_3_MET1	Nov 22, 2019		Soil	M19-No38233	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_ GS1_3_MET2	Nov 22, 2019		Soil	M19-No38234	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_ GS1_3_PSD1	Nov 22, 2019		Soil	M19-No38235	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	THYLACINE_ GS1_MET2	Nov 22, 2019		Soil	M19-No38236	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	THYLACINE_ GS-1_MET1	Nov 22, 2019		Soil	M19-No38237	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	THYLACINE_	Nov 22, 2019		Soil	M19-No38238	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS-1_PSD1																				
7	THYLACINE_ GS1-2_PSD1	Nov 22, 2019		Soil	M19-No38239	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
8	THYLACINE_ GS1-2_MET1	Nov 22, 2019		Soil	M19-No38240	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
9	THYLACINE_ GS1-2_MET2	Nov 22, 2019		Soil	M19-No38241	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
10	THYLACINE_ GS2_PSD1	Nov 22, 2019		Soil	M19-No38242	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
11	THYLACINE_ GS2_MET1	Nov 22, 2019		Soil	M19-No38243	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
12	THYLACINE_ GS2_MET2	Nov 22, 2019		Soil	M19-No38244	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
13	ARTISON-	Nov 22, 2019		Soil	M19-No38245	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS_A_PAR 4																				
14	ARTISON-GS_A_PAR 3	Nov 22, 2019		Soil	M19-No38246	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
15	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M19-No38247	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
16	ARTISON-GSA_PAR1	Nov 22, 2019		Soil	M19-No38248	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
17	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M19-No38249	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
18	ARTISON-GSA_PAR2	Nov 22, 2019		Soil	M19-No38250	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
19	ARTISON-GS3_PAR1	Nov 22, 2019		Soil	M19-No38251	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
20	ARTISON-	Nov 22, 2019		Soil	M19-No38252	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Environment Testing

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Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS3_MET1																				
21	ARTISON-GS3_PAR 4	Nov 22, 2019		Soil	M19-No38253	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
22	ARTISON-GS3_PAR 2	Nov 22, 2019		Soil	M19-No38254	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
23	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M19-No38255	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
24	ARTISON-GS3_PAR 3	Nov 22, 2019		Soil	M19-No38256	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
25	ARTISON-1	Nov 22, 2019		Filter paper	M19-No38257					X											
26	ARTISON-5	Nov 22, 2019		Filter paper	M19-No38258					X											
27	ARTISON-2	Nov 22, 2019		Filter paper	M19-No38259					X											
28	THYLACINE GS1_3	Nov 22, 2019		Filter paper	M19-No38260					X											

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Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
29	THYLACINE GS1_1	Nov 22, 2019		Filter paper	M19-No38261					X											
30	THYLACINE GS1_2	Nov 22, 2019		Filter paper	M19-No38262					X											
Test Counts						24	24	24	24	6	24	24	24	24	24	24	24	24	24	24	24

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Robert Johnston	Analytical Services Manager
Julie Kay	Senior Analyst-Inorganic (VIC)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

APPENDIX 3
SEDIMENT QUALITY LABORATORY REPORT

eurofins | Environment Testing

Certificate of Analysis

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Dan McClary**

Report	**690387-S**
Project name	OTWAY OFFSHORE EBS
Project ID	318000803
Received Date	Dec 04, 2019

Client Sample ID			THYLACINE_GS1_3_MET1	THYLACINE_GS1_3_MET2	THYLACINE_GS1_3_PSD1	THYLACINE_GS1_MET2
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M19-No38233	M19-No38234	M19-No38235	M19-No38236
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
% Clay	1	%	4.7	3.1	3.3	3.7
% Sand		%	95	95	97	96
% Silt		%	< 1	1.6	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	130	71	110	160
Total Nitrogen (as N)*	10	mg/kg	130	71	110	160
Total Organic Carbon	0.1	%	0.5	1.8	2.7	4.8
Phosphorus	5	mg/kg	400	660	740	610
Silicon (Aqua regia extractable)	5	mg/kg	950	750	630	970
% Moisture	1	%	37	34	37	36
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.4	5.7	5.6	6.7
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	7.8	< 5

Client Sample ID			THYLACINE_GS-1_MET1	THYLACINE_GS-1_PSD1	THYLACINE_GS1-2_PSD1	THYLACINE_GS1-2_MET1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M19-No38237	M19-No38238	M19-No38239	M19-No38240
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
% Clay	1	%	2.8	1.7	4.4	3.1
% Sand		%	96	98	96	95
% Silt		%	1.4	< 1	< 1	1.5
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	230	210	310	190
Total Nitrogen (as N)*	10	mg/kg	230	210	310	190
Total Organic Carbon	0.1	%	1.3	0.4	1.9	0.9

Client Sample ID			THYLACINE_GS-1_MET1	THYLACINE_GS-1_PSD1	THYLACINE_GS1-2_PSD1	THYLACINE_GS1-2_MET1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38237**	**M19-No38238**	**M19-No38239**	**M19-No38240**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Phosphorus	5	mg/kg	750	870	550	620
Silicon (Aqua regia extractable)	5	mg/kg	850	940	890	1000
% Moisture	1	%	34	35	37	38
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.2	5.7	5.2	6.6
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	7.2	< 5	< 5	< 5

Client Sample ID			THYLACINE_GS1-2_MET2	THYLACINE_GS2_PSD1	THYLACINE_GS2_MET1	THYLACINE_GS2_MET2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38241**	**M19-No38242**	**M19-No38243**	**M19-No38244**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	3.9	2.5	3.3	2.9
% Sand		%	96	98	97	97
% Silt		%	< 1	< 1	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	260	290	180	220
Total Nitrogen (as N)*	10	mg/kg	260	290	180	220
Total Organic Carbon	0.1	%	1.4	1.7	< 0.1	0.5
Phosphorus	5	mg/kg	630	830	< 200	500
Silicon (Aqua regia extractable)	5	mg/kg	980	700	460	600
% Moisture	1	%	38	39	35	38
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	5.1	5.7	< 5	6.3
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	< 5	< 5

Client Sample ID			ARTISON-GS_A_PAR 4	ARTISON-GS_A_PAR 3	ARTISON-GSA_MET1	ARTISON-GSA_PAR1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38245**	**M19-No38246**	**M19-No38247**	**M19-No38248**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
% Clay	1	%	< 1	< 1	3.6	3.1
% Sand		%	100	97	96	95
% Silt		%	< 1	2.9	< 1	1.5
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	340	370	310	250
Total Nitrogen (as N)*	10	mg/kg	340	370	310	250
Total Organic Carbon	0.1	%	< 0.1	< 0.1	1.6	0.4
Phosphorus	5	mg/kg	< 200	860	620	440
Silicon (Aqua regia extractable)	5	mg/kg	490	630	570	580
% Moisture	1	%	34	34	37	29
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	8.0	7.4	11	6.9
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	5.2	9.0	9.4	< 5

Client Sample ID			ARTISON-GSA_MET2	ARTISON-GSA_PAR2	ARTISON-GS3_PAR1	ARTISON-GS3_MET1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38249**	**M19-No38250**	**M19-No38251**	**M19-No38252**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
% Clay	1	%	3.7	3.0	3.9	4.1
% Sand		%	96	97	96	96
% Silt		%	< 1	< 1	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	370	340	440	270
Total Nitrogen (as N)*	10	mg/kg	370	340	440	270
Total Organic Carbon	0.1	%	< 0.1	1.1	< 0.1	2.4
Phosphorus	5	mg/kg	460	< 200	730	530
Silicon (Aqua regia extractable)	5	mg/kg	600	520	770	810
% Moisture	1	%	34	34	36	35
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.0	6.4	6.6	8.1
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	6.9	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	25	5.4	< 5	< 5

Client Sample ID			ARTISON-GS3_PAR 4	ARTISON-GS3_PAR 2	ARTISON-GS3_MET 2	ARTISON-GS3_PAR 3
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38253**	**M19-No38254**	**M19-No38255**	**M19-No38256**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	4.8	3.5	3.6	4.0
% Sand		%	95	95	96	96
% Silt		%	< 1	1.8	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	310	270	150	310
Total Nitrogen (as N)*	10	mg/kg	310	270	150	310
Total Organic Carbon	0.1	%	0.6	4.9	1.6	1.8
Phosphorus	5	mg/kg	570	400	390	480
Silicon (Aqua regia extractable)	5	mg/kg	830	520	650	640
% Moisture	1	%	36	35	34	34
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	9.0	8.1	9.5	8.0
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	< 5	< 5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
% Clay	Brisbane	Dec 13, 2019	0 Days
- Method: LTM-GEN-7040			
% Sand	Brisbane	Dec 09, 2019	0 Days
- Method: LTM-GEN-7040			
% Silt	Brisbane	Dec 09, 2019	0 Days
- Method: LTM-GEN-7040			
Total Organic Carbon	Melbourne	Dec 16, 2019	28 Days
- Method: LTM-INO-4060 Total Organic Carbon in water and soil			
Silicon (Aqua regia extractable)	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon and Phosphorus by ICP-AES			
Heavy Metals	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	Melbourne	Dec 06, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Dec 06, 2019	28 Days
- Method: LTM-INO-4310 TKN in Waters & Soils by FIA			
Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P			
Phosphorus	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon and Phosphorus by ICP-AES			
% Moisture	Melbourne	Nov 27, 2019	14 Days
- Method: LTM-GEN-7080 Moisture			

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NATA # 1261 Site # 20794

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NATA # 1261
Site # 23736

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Dec 4, 2019 1:54 PM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
External Laboratory																					
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																
1	THYLACINE_ GS1_3_MET1	Nov 22, 2019		Soil	M19-No38233	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_ GS1_3_MET2	Nov 22, 2019		Soil	M19-No38234	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_ GS1_3_PSD1	Nov 22, 2019		Soil	M19-No38235	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	THYLACINE_ GS1_MET2	Nov 22, 2019		Soil	M19-No38236	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	THYLACINE_ GS-1_MET1	Nov 22, 2019		Soil	M19-No38237	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	THYLACINE_	Nov 22, 2019		Soil	M19-No38238	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS-1_PSD1																				
7	THYLACINE_GS1-2_PSD1	Nov 22, 2019		Soil	M19-No38239	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
8	THYLACINE_GS1-2_MET1	Nov 22, 2019		Soil	M19-No38240	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
9	THYLACINE_GS1-2_MET2	Nov 22, 2019		Soil	M19-No38241	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
10	THYLACINE_GS2_PSD1	Nov 22, 2019		Soil	M19-No38242	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
11	THYLACINE_GS2_MET1	Nov 22, 2019		Soil	M19-No38243	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
12	THYLACINE_GS2_MET2	Nov 22, 2019		Soil	M19-No38244	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
13	ARTISON-	Nov 22, 2019		Soil	M19-No38245	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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NATA # 1261 Site # 20794

Perth
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NATA # 1261
Site # 23736

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Dec 4, 2019 1:54 PM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS_A_PAR 4																				
14	ARTISON-GS_A_PAR 3	Nov 22, 2019		Soil	M19-No38246	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
15	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M19-No38247	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
16	ARTISON-GSA_PAR1	Nov 22, 2019		Soil	M19-No38248	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
17	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M19-No38249	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
18	ARTISON-GSA_PAR2	Nov 22, 2019		Soil	M19-No38250	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
19	ARTISON-GS3_PAR1	Nov 22, 2019		Soil	M19-No38251	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
20	ARTISON-	Nov 22, 2019		Soil	M19-No38252	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS3_MET1																				
21	ARTISON-GS3_PAR 4	Nov 22, 2019		Soil	M19-No38253	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
22	ARTISON-GS3_PAR 2	Nov 22, 2019		Soil	M19-No38254	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
23	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M19-No38255	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
24	ARTISON-GS3_PAR 3	Nov 22, 2019		Soil	M19-No38256	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
25	ARTISON-1	Nov 22, 2019		Filter paper	M19-No38257					X											
26	ARTISON-5	Nov 22, 2019		Filter paper	M19-No38258					X											
27	ARTISON-2	Nov 22, 2019		Filter paper	M19-No38259					X											
28	THYLACINE GS1_3	Nov 22, 2019		Filter paper	M19-No38260					X											

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Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
29	THYLACINE GS1_1	Nov 22, 2019		Filter paper	M19-No38261					X											
30	THYLACINE GS1_2	Nov 22, 2019		Filter paper	M19-No38262					X											
Test Counts						24	24	24	24	6	24	24	24	24	24	24	24	24	24	24	24

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Environment Testing

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

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Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
% Clay			%	< 1			1	Pass	
Nitrate & Nitrite (as N)			mg/kg	< 5			5	Pass	
Total Kjeldahl Nitrogen (as N)			mg/kg	< 10			10	Pass	
Total Organic Carbon			%	< 0.1			0.1	Pass	
Method Blank									
Heavy Metals									
Cadmium			mg/kg	< 0.4			0.4	Pass	
Chromium			mg/kg	< 5			5	Pass	
Copper			mg/kg	< 5			5	Pass	
Lead			mg/kg	< 5			5	Pass	
Mercury			mg/kg	< 0.1			0.1	Pass	
Nickel			mg/kg	< 5			5	Pass	
Tin			mg/kg	< 10			10	Pass	
Zinc			mg/kg	< 5			5	Pass	
LCS - % Recovery									
% Clay			%	93			70-130	Pass	
Total Organic Carbon			%	107			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Cadmium			%	101			80-120	Pass	
Chromium			%	117			80-120	Pass	
Copper			%	118			80-120	Pass	
Lead			%	114			80-120	Pass	
Mercury			%	112			75-125	Pass	
Nickel			%	114			80-120	Pass	
Tin			%	112			80-120	Pass	
Zinc			%	116			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Heavy Metals				Result 1					
Cadmium	M19-No38239	CP	%	94			75-125	Pass	
Chromium	M19-No38239	CP	%	83			75-125	Pass	
Copper	M19-No38239	CP	%	84			75-125	Pass	
Lead	M19-No38239	CP	%	87			75-125	Pass	
Mercury	M19-No38239	CP	%	101			70-130	Pass	
Nickel	M19-No38239	CP	%	85			75-125	Pass	
Tin	M19-No38239	CP	%	87			75-125	Pass	
Zinc	M19-No38239	CP	%	83			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M19-De07683	NCP	%	3.0	3.0	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Clay	M19-Oc40940	NCP	%	5.0	6.3	22	30%	Pass	
% Sand	M19-Oc40940	NCP	%	91	90	1.0	30%	Pass	
% Silt	M19-Oc40940	NCP	%	3.8	3.8	<1	30%	Pass	
Nitrate & Nitrite (as N)	M19-No38234	CP	mg/kg	< 5	< 5	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38238	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38238	CP	mg/kg	5.7	5.8	1.0	30%	Pass	
Copper	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38238	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38238	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38239	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38239	CP	mg/kg	5.2	5.5	6.0	30%	Pass	
Copper	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38239	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38239	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38248	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38248	CP	mg/kg	6.9	6.8	1.0	30%	Pass	
Copper	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38248	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38248	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38248	CP	mg/kg	< 5	6.3	54	30%	Fail	Q15
Duplicate									
				Result 1	Result 2	RPD			
Total Organic Carbon	M19-No38249	CP	%	< 0.1	< 0.1	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Robert Johnston	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal (VIC)
Jonathon Angell	Senior Analyst-Inorganic (QLD)
Julie Kay	Senior Analyst-Inorganic (VIC)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Certificate of Analysis

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Serena Orr**

Report **700321-S**
Project name OTWAY OFFSHORE EBS
Project ID 318000803
Received Date Feb 05, 2020

Client Sample ID			**THYLACINE_GS1_3_MET1**	**THYLACINE_GS1_3_MET2**	**THYLACINE_GS1_MET2**	**THYLACINE_GS-1_MET1**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05003**	**M20-Fe05004**	**M20-Fe05005**	**M20-Fe05006**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	106	86	112	104
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5

Client Sample ID			THYLACINE_GS1_3_MET1	THYLACINE_GS1_3_MET2	THYLACINE_GS1_MET2	THYLACINE_GS-1_MET1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M20-Fe05003	M20-Fe05004	M20-Fe05005	M20-Fe05006
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	97	54	83	92
p-Terphenyl-d14 (surr.)	1	%	118	81	103	121
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	78	99	78	132
Tetrachloro-m-xylene (surr.)	1	%	77	51	55	77
% Moisture	1	%	33	35	36	32

Client Sample ID			THYLACINE_GS1-2_MET1	THYLACINE_GS1-2_MET2	THYLACINE_GS2_MET1	THYLACINE_GS2_MET2
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M20-Fe05007	M20-Fe05008	M20-Fe05009	M20-Fe05010
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	110	62	55	61

Client Sample ID			THYLACINE_G S1-2_MET1	THYLACINE_G S1-2_MET2	THYLACINE_G S2_MET1	THYLACINE_G S2_MET2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05007**	**M20-Fe05008**	**M20-Fe05009**	**M20-Fe05010**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	87	75	79	91
p-Terphenyl-d14 (surr.)	1	%	137	88	83	57
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	139	112	105	64
Tetrachloro-m-xylene (surr.)	1	%	80	90	86	75
% Moisture	1	%	37	35	33	35

Client Sample ID			ARTISON-GSA_MET1	ARTISON-GSA_MET2	ARTISON-GS3_MET1	ARTISON-GS3_MET 2
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M20-Fe05011	M20-Fe05012	M20-Fe05013	M20-Fe05014
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	62	57	106	55
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	60	77	58	67
p-Terphenyl-d14 (surr.)	1	%	59	125	147	56

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Environment Testing

Client Sample ID			ARTISON-GSA_MET1	ARTISON-GSA_MET2	ARTISON-GS3_MET1	ARTISON-GS3_MET 2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05011**	**M20-Fe05012**	**M20-Fe05013**	**M20-Fe05014**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	73	89	115	110
Tetrachloro-m-xylene (surr.)	1	%	64	88	54	72
% Moisture	1	%	33	30	34	34

Environment Testing

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Feb 05, 2020	
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Polychlorinated Biphenyls	Melbourne	Feb 05, 2020	28 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8082)			
% Moisture	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-GEN-7080 Moisture			

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Feb 5, 2020 3:36 AM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	700321	**Due:**	Feb 12, 2020
		Phone:	08 9225 5199	**Priority:**	5 Day
		Fax:		**Contact Name:**	Serena Orr
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Polycyclic Aromatic Hydrocarbons	Polychlorinated Biphenyls	BTEX	Moisture Set	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	THYLACINE_GS1_3_MET1	Nov 22, 2019		Soil	M20-Fe05003	X	X	X	X	X
2	THYLACINE_GS1_3_MET2	Nov 22, 2019		Soil	M20-Fe05004	X	X	X	X	X
3	THYLACINE_GS1_MET2	Nov 22, 2019		Soil	M20-Fe05005	X	X	X	X	X
4	THYLACINE_GS-1_MET1	Nov 22, 2019		Soil	M20-Fe05006	X	X	X	X	X
5	THYLACINE_GS1-2_MET1	Nov 22, 2019		Soil	M20-Fe05007	X	X	X	X	X
6	THYLACINE_GS1-2_MET2	Nov 22, 2019		Soil	M20-Fe05008	X	X	X	X	X

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IANZ # 1290

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Feb 5, 2020 3:36 AM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	700321	**Due:**	Feb 12, 2020
		Phone:	08 9225 5199	**Priority:**	5 Day
		Fax:		**Contact Name:**	Serena Orr
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Polycyclic Aromatic Hydrocarbons	Polychlorinated Biphenyls	BTEX	Moisture Set	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
7	THYLACINE_GS2_MET1	Nov 22, 2019		Soil	M20-Fe05009	X	X	X	X	X
8	THYLACINE_GS2_MET2	Nov 22, 2019		Soil	M20-Fe05010	X	X	X	X	X
9	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M20-Fe05011	X	X	X	X	X
10	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M20-Fe05012	X	X	X	X	X
11	ARTISON-GS3_MET1	Nov 22, 2019		Soil	M20-Fe05013	X	X	X	X	X
12	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M20-Fe05014	X	X	X	X	X
Test Counts						12	12	12	12	12

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Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.1			0.1	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.1			0.1	Pass	
Aroclor-1242	mg/kg	< 0.1			0.1	Pass	
Aroclor-1248	mg/kg	< 0.1			0.1	Pass	
Aroclor-1254	mg/kg	< 0.1			0.1	Pass	
Aroclor-1260	mg/kg	< 0.1			0.1	Pass	
Total PCB*	mg/kg	< 0.1			0.1	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	96			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
TRH C10-C14	%	85			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	100			70-130	Pass	
Toluene	%	98			70-130	Pass	
Ethylbenzene	%	91			70-130	Pass	
m&p-Xylenes	%	93			70-130	Pass	
Xylenes - Total	%	94			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	120			70-130	Pass	
TRH C6-C10	%	91			70-130	Pass	
TRH >C10-C16	%	81			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	109			70-130	Pass	
Acenaphthylene	%	117			70-130	Pass	
Anthracene	%	124			70-130	Pass	
Benz(a)anthracene	%	120			70-130	Pass	
Benzo(a)pyrene	%	96			70-130	Pass	
Benzo(b&j)fluoranthene	%	108			70-130	Pass	
Benzo(g.h.i)perylene	%	90			70-130	Pass	
Benzo(k)fluoranthene	%	86			70-130	Pass	
Chrysene	%	95			70-130	Pass	
Dibenz(a.h)anthracene	%	103			70-130	Pass	
Fluoranthene	%	120			70-130	Pass	
Fluorene	%	119			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	99			70-130	Pass	
Naphthalene	%	107			70-130	Pass	
Phenanthrene	%	110			70-130	Pass	
Pyrene	%	120			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	105			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	N20-Fe00759	NCP	%	89			70-130	Pass	
TRH C10-C14	N20-Fe03039	NCP	%	79			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	N20-Fe00759	NCP	%	93			70-130	Pass	
Toluene	N20-Fe00759	NCP	%	93			70-130	Pass	
Ethylbenzene	N20-Fe00759	NCP	%	84			70-130	Pass	
m&p-Xylenes	N20-Fe00759	NCP	%	86			70-130	Pass	
o-Xylene	N20-Fe00759	NCP	%	91			70-130	Pass	
Xylenes - Total	N20-Fe00759	NCP	%	88			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	N20-Fe00759	NCP	%	100			70-130	Pass	
TRH C6-C10	N20-Fe00759	NCP	%	87			70-130	Pass	
TRH >C10-C16	N20-Fe03039	NCP	%	77			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Acenaphthene	S20-Ja29582	NCP	%	87			70-130	Pass	
Acenaphthylene	S20-Ja29582	NCP	%	91			70-130	Pass	
Anthracene	S20-Ja29582	NCP	%	94			70-130	Pass	
Benz(a)anthracene	S20-Ja29582	NCP	%	87			70-130	Pass	
Benzo(a)pyrene	S20-Ja29582	NCP	%	113			70-130	Pass	
Benzo(b&j)fluoranthene	S20-Ja29582	NCP	%	102			70-130	Pass	
Benzo(g.h.i)perylene	S20-Ja29582	NCP	%	101			70-130	Pass	
Benzo(k)fluoranthene	S20-Ja29582	NCP	%	84			70-130	Pass	
Chrysene	S20-Ja29582	NCP	%	95			70-130	Pass	
Dibenz(a.h)anthracene	S20-Ja29582	NCP	%	105			70-130	Pass	
Fluoranthene	S20-Ja29582	NCP	%	90			70-130	Pass	
Fluorene	S20-Ja29582	NCP	%	95			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S20-Ja29582	NCP	%	112			70-130	Pass	
Naphthalene	S20-Ja29582	NCP	%	128			70-130	Pass	
Phenanthrene	S20-Ja29582	NCP	%	85			70-130	Pass	
Pyrene	S20-Ja29582	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1016	M20-Ja30810	NCP	%	88			70-130	Pass	
Aroclor-1260	M20-Ja30810	NCP	%	90			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M20-Fe05006	CP	%	32	32	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1221	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1242	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1248	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1254	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1260	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Total PCB*	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	M20-Fe05012	CP	mg/kg	< 20	< 20	<1	30%	Pass	

Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	M20-Fe05012	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	M20-Fe05012	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	M20-Fe05012	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	M20-Fe05012	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	M20-Fe05014	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	M20-Fe05014	CP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	M20-Fe05014	CP	mg/kg	< 100	< 100	<1	30%	Pass	

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	No
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised By

Robert Johnston	Analytical Services Manager
Harry Bacalis	Senior Analyst-Volatile (VIC)
Joseph Edouard	Senior Analyst-Organic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

APPENDIX 4
DROP CAMERA SITES (GDA94 UTM 54 S)

Date	Site	Easting	Northing	Depth (m LAT)
31/10/2019	DC_AR2	664260	5693556	69.5
	DC_AR3	663741	5694457	69.6
	DC_AR4	662262	5693605	70.8
	DC_AR1	662782	5692701	70.9
20/11/2019	DC_TH5	658145	5656139	107.1
21/11/2019	DC_TH8	657791	5656967	104.9
	DC_TH8_4m	657796	5656969	104.9
	DC_TH8_8m	657800	5656972	104.9
	DC_TH6	659801	5656919	101.9
	DC_TH6_4m	659810	5656925	101.9
	DC_TH6_8m	659810	5656923	101.9
	DC_TH7	659211	5657774	103.5
	DC_TH7_4m	659213	5657774	103.5
9/12/2019	DC_TH4	660880	5658431	98.9
	DC_TH4_2m	660880	5658428	98.9
	DC_TH4_5m	660881	5658432	98.9
	DC_TH1	661398	5657534	96.8
	DC_TH1_2m	661397	5657532	96.8
	DC_TH1_5m	661397	5657539	96.8
	DC_TH2	662970	5658384	96.9
	DC_TH2_2m	662972	5658383	96.9
	DC_TH2_5m	662975	5658387	96.9
	DC_TH3	662409	5659275	98.2
	DC_TH3_2m	662412	5659274	98.2
	DC_TH3_5m	662406	5659277	98.2
25/12/2019	DC_GE1	668217	5668519	85.6
	DC_GE2	669700	5669375	85.0
	DC_GE2_2m	669703	5669375	85.0
	DC_GE2_5m	669704	5669377	85.0
	DC_GE3	669179	5670280	82.3
	DC_GE3_2m	669180	5670279	82.3
	DC_GE3_5m	669184	5670277	82.3
	DC_GE4	667699	5669424	83.4
	DC_GE4_2m	667700	5669424	83.4
	DC_GE4_5m	667704	5669422	83.4
28/12/2019	DC_LB1	647832	5681521	92.5
	DC_LB1_2m	647831	5681519	92.5
	DC_LB1_5m	647831	5681516	92.5
	DC_LB4	646558	5680703	97.8
	DC_LB4_2m	646560	5680702	97.8

Date	Site	Easting	Northing	Depth (m LAT)
	DC_LB4_5m	646560	5680700	97.8
	DC_LB4_Extra	646438	5680699	97.8
21/01/2020	DC_LB2R	645891	5681544	93.1
	DC_LB2R_2m	645889	5681543	93.1
	DC_LB2R_5m	645891	5681541	93.1
	DC_LB3R	647415	5682484	93.6
	DC_LB3R_2m	647415	5682479	93.6
	DC_LB3R_5m	647418	5682479	93.6
	DC_HE4R	662560	5687719	74.3
	DC_HE4R_1m	662560	5687719	74.3
	DC_HE4R_3m	662557	5687717	74.3
	DC_HE2	662068	5688635	74.3
	DC_HE2_1m	662066	5688636	74.3
	DC_HE2_3m	662064	5688637	74.3
	DC_HE1	664068	5688640	73.4
	DC_HE1_1m	664068	5688643	73.4
	DC_HE1_3m	664066	5688641	73.4
	DC_HE3	663548	5689514	73.8
	DC_HE3_1m	663548	5689515	73.8
	DC_HE3_3m	663544	5689514	73.8
	DC_HTX1R	669286	5688662	72.9
	DC_HTX1R_1m	669286	5688661	72.9
	DC_HTX1R_2m	669290	5688661	72.9
22/01/2020	DC_ARHTX1R	665451	5691790	70.5
	DC_ARHTX1R_2m	665452	5691788	70.5
	DC_ARHTX1R_5m	665452	5691788	70.5
29/01/2020	DC_ARHTY1R	665896	5694722	69.3
	DC_ARHTY1R_B	665895	5694725	69.3
	DC_ARHTY1R_C	665899	5694726	69.3
	DC_HTY1R_A	670385	5696817	67.9
	DC_HTY1R_B	670382	5696816	67.9
	DC_HTY1R_C	670384	5696816	67.9
	DC_ARGE3R_A	665383	5684033	76.4
	DC_ARGE3R_B	665383	5684033	76.8
	DC_ARGE3R_C	665382	5684030	76.7
	DC_ARGE3R_D	665381	5684028	76.2
	DC_ARGE6R_A	667106	5676840	76.9
	DC_ARGE6R_B	667108	5676837	74.7
	DC_ARGE6R_C	667109	5676835	77.6
	DC_ARGE7R_A	667735	5673842	79.4

Date	Site	Easting	Northing	Depth (m LAT)
30/01/2020	DC_ARGE7R_B	667735	5673845	79.4
	DC_ARGE7R_C	667736	5673849	79.4
	DC_ARLB2R_A	659391	5690760	73.6
	DC_ARLB2R_B	659390	5690760	73.6
	DC_ARLB2R_C	659391	5690757	73.6
	DC_ARLB6R_A	651030	5684616	87.1
	DC_ARLB6R_B	651030	5684615	87.1
	DC_ARLB6R_C	651031	5684613	87.1
	DC_LBGE3R_A	653038	5677641	98.5
	DC_LBGE3R_B	653039	5677640	98.5
	DC_LBGE3R_C	653040	5677638	98.5
	DC_LBGE6R_A	659466	5673506	88.2
	DC_LBGE6R_B	659467	5673504	88.2
	DC_LBGE6R_C	659468	5673503	88.2

APPENDIX 5
SEABED PHOTOGRAPH ASSESSMENT DATA

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
ARGE	Routes_ARGE_ARGE3R_A_00001	20									
ARGE	Routes_ARGE_ARGE3R_A_00002	10							1		
ARGE	Routes_ARGE_ARGE3R_A_00005	15		5	1						
ARGE	Routes_ARGE_ARGE3R_A_00006	25									
ARGE	Routes_ARGE_ARGE3R_A_00007	5		1							
ARGE	Routes_ARGE_ARGE3R_B_00005	15									
ARGE	Routes_ARGE_ARGE3R_B_00006	5									
ARGE	Routes_ARGE_ARGE3R_B_00007	5									
ARGE	Routes_ARGE_ARGE3R_C_00001	0									
ARGE	Routes_ARGE_ARGE3R_C_00003	5									
ARGE	Routes_ARGE_ARGE3R_C_00004	0									
ARGE	Routes_ARGE_ARGE3R_C_00005	5									
ARGE	Routes_ARGE_ARGE6R_A_00001	0									
ARGE	Routes_ARGE_ARGE6R_A_00002	0									
ARGE	Routes_ARGE_ARGE6R_A_00003	5									
ARGE	Routes_ARGE_ARGE6R_A_00004	0									
ARGE	Routes_ARGE_ARGE6R_A_00005	0									
ARGE	Routes_ARGE_ARGE6R_A_00006	0									
ARGE	Routes_ARGE_ARGE6R_A_00007	5									
ARGE	Routes_ARGE_ARGE6R_B_00001	0									
ARGE	Routes_ARGE_ARGE6R_B_00002	5									
ARGE	Routes_ARGE_ARGE6R_B_00003	5									
ARGE	Routes_ARGE_ARGE6R_B_00005	5									
ARGE	Routes_ARGE_ARGE6R_B_00006	5									
ARGE	Routes_ARGE_ARGE6R_B_00007	5									
ARGE	Routes_ARGE_ARGE6R_B_00008	0									
ARGE	Routes_ARGE_ARGE6R_B_00009	5									
ARGE	Routes_ARGE_ARGE6R_C_00001	5									
ARGE	Routes_ARGE_ARGE6R_C_00002	0									
ARGE	Routes_ARGE_ARGE6R_C_00003	5									
ARGE	Routes_ARGE_ARGE6R_C_00004	0									1
ARGE	Routes_ARGE_ARGE6R_C_00005	0		1							
ARGE	Routes_ARGE_ARGE7R_A_00001	5									
ARGE	Routes_ARGE_ARGE7R_A_00002	15									
ARGE	Routes_ARGE_ARGE7R_A_00004	10									
ARGE	Routes_ARGE_ARGE7R_A_00005	25		1							
ARGE	Routes_ARGE_ARGE7R_B_00004	5									
ARGE	Routes_ARGE_ARGE7R_B_00005	10									
ARGE	Routes_ARGE_ARGE7R_B_00006	20									
ARGE	Routes_ARGE_ARGE7R_B_00007	15									
ARGE	Routes_ARGE_ARGE7R_B_00008	20									
ARGE	Routes_ARGE_ARGE7R_B_00009	20									
ARGE	Routes_ARGE_ARGE7R_B_00011	25		1							
ARGE	Routes_ARGE_ARGE7R_B_00012	15				1					

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
ARGE	Routes_ARGE_ARGE7R_B_00015	25									
ARGE	Routes_ARGE_ARGE7R_C_00001	35									
ARGE	Routes_ARGE_ARGE7R_C_00002	10									
ARGE	Routes_ARGE_ARGE7R_C_00004	35									
ARGE	Routes_ARGE_ARGE7R_C_00005	5									1
ARGE	Routes_ARGE_ARGE7R_C_00006	30		1							
ARHTY	Routes_ARHTY_ARHTYR1_A_00001	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00002	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00003	20									
ARHTY	Routes_ARHTY_ARHTYR1_A_00004	25									
ARHTY	Routes_ARHTY_ARHTYR1_A_00005	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00006	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00008	0									1
ARHTY	Routes_ARHTY_ARHTYR1_A_00009	0						1			
ARHTY	Routes_ARHTY_ARHTYR1_B_00001	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00003	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00004	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00005	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00006	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00008	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00001	40	1								
ARHTY	Routes_ARHTY_ARHTYR1_C_00002	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00004	20									
ARHTY	Routes_ARHTY_ARHTYR1_C_00006	5									
ARHTY	Routes_ARHTY_ARHTYR1_C_00007	0		1							
ARHTY	Routes_ARHTY_ARHTYR1_C_00008	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00009	0								1	
ARLB	Routes_ARLB_ARLB2R_A_00001	20									
ARLB	Routes_ARLB_ARLB2R_A_00005	20									
ARLB	Routes_ARLB_ARLB2R_A_00006	20									
ARLB	Routes_ARLB_ARLB2R_A_00007	30									
ARLB	Routes_ARLB_ARLB2R_A_00008	15		1							
ARLB	Routes_ARLB_ARLB2R_A_00009	20									
ARLB	Routes_ARLB_ARLB2R_A_00010	20									
ARLB	Routes_ARLB_ARLB2R_B_00001	5									
ARLB	Routes_ARLB_ARLB2R_B_00002	20									
ARLB	Routes_ARLB_ARLB2R_B_00003	20		2	1						
ARLB	Routes_ARLB_ARLB2R_B_00004	20									
ARLB	Routes_ARLB_ARLB2R_B_00005	20									
ARLB	Routes_ARLB_ARLB2R_C_00001	5		1							
ARLB	Routes_ARLB_ARLB2R_C_00003	5									
ARLB	Routes_ARLB_ARLB2R_C_00004	0									
ARLB	Routes_ARLB_ARLB2R_C_00005	5									
ARLB	Routes_ARLB_ARLB2R_C_00006	5		1							

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
ARLB	Routes_ARLB_ARLB6R_A_00002	0									
ARLB	Routes_ARLB_ARLB6R_A_00003	5				1					
ARLB	Routes_ARLB_ARLB6R_A_00004	0									
ARLB	Routes_ARLB_ARLB6R_A_00005	5		1							
ARLB	Routes_ARLB_ARLB6R_B_00001	0									
ARLB	Routes_ARLB_ARLB6R_B_00002	0									
ARLB	Routes_ARLB_ARLB6R_B_00004	0									
ARLB	Routes_ARLB_ARLB6R_B_00005	0									
ARLB	Routes_ARLB_ARLB6R_B_00006	0		3							
ARLB	Routes_ARLB_ARLB6R_C_00001	0									
ARLB	Routes_ARLB_ARLB6R_C_00002	0									
ARLB	Routes_ARLB_ARLB6R_C_00003	0									
ARLB	Routes_ARLB_ARLB6R_C_00004	0									
ARLB	Routes_ARLB_ARLB6R_C_00005	0		1							
ARLB	Routes_ARLB_ARLB6R_C_00007	5		2							
Artisan	Artisan_AR1_00015	30									
Artisan	Artisan_AR1_00017	5									
Artisan	Artisan_AR1_00029	40		3							
Artisan	Artisan_AR1_00035	30		1							
Artisan	Artisan_AR2_00007	35									
Artisan	Artisan_AR2_00008	15									
Artisan	Artisan_AR2_00011	40									
Artisan	Artisan_AR2_00012	30		1							
Artisan	Artisan_AR3_00004	20									
Artisan	Artisan_AR3_00006	15									
Artisan	Artisan_AR3_00008	5									
Artisan	Artisan_AR3_00015	40									
Artisan	Artisan_AR3_00017	25									
Artisan	Artisan_AR3_00018	20		1							
Artisan	Artisan_AR3_00019	10									
Artisan	Artisan_AR3_00022	5									
Artisan	Artisan_AR3_00023	25									
Artisan	Artisan_AR4_00004	30		3							
Artisan	Artisan_AR4_00005	5									
Artisan	Artisan_AR4_00007	20		2							
Artisan	Artisan_AR4_00009	10									
Artisan	Artisan_AR4_00012	45									
Artisan	Artisan_AR4_00013	30									
Artisan	Artisan_AR4_00016	10		1							
Artisan	Artisan_AR4_00017	30		1							
Artisan	Artisan_AR4_00018	20		1							
Artisan	Artisan_AR4_00019	5		1							
Artisan	Artisan_AR4_00025	15		2							
Artisan	Artisan_AR4_00031	15		3							

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Artisan	Artisan_AR4_00034	40									
Geographe	Geographe_GE1_A_00004	55									
Geographe	Geographe_GE1_A_00007	35									
Geographe	Geographe_GE1_A_00008	45		2							
Geographe	Geographe_GE1_B_00001	0									
Geographe	Geographe_GE1_B_00002	0	1								
Geographe	Geographe_GE1_B_00004	5									
Geographe	Geographe_GE1_B_00005	5									
Geographe	Geographe_GE1_C_00001	5									
Geographe	Geographe_GE1_C_00005	25	1								
Geographe	Geographe_GE2_A_00001	5									
Geographe	Geographe_GE2_A_00002	5									
Geographe	Geographe_GE2_A_00003	10	1								
Geographe	Geographe_GE2_A_00005	25									
Geographe	Geographe_GE2_B_00002	5									
Geographe	Geographe_GE2_B_00003	5									
Geographe	Geographe_GE2_C_00002	0									
Geographe	Geographe_GE2_C_00004	0									
Geographe	Geographe_GE2_C_00005	0									
Geographe	Geographe_GE3_A_00001	5									
Geographe	Geographe_GE3_A_00003	5									
Geographe	Geographe_GE3_A_00005	25									
Geographe	Geographe_GE3_B_00001	5									
Geographe	Geographe_GE3_B_00003	20									
Geographe	Geographe_GE3_B_00005	30									
Geographe	Geographe_GE3_C_00002	35									
Geographe	Geographe_GE3_C_00005	40		1							
Geographe	Geographe_GE3_C_00006	10									
Geographe	Geographe_GE4_A_00002	35									
Geographe	Geographe_GE4_A_00004	5									
Geographe	Geographe_GE4_A_00005	30									
Geographe	Geographe_GE4_A_00006	0		1							
Geographe	Geographe_GE4_B_00002	5									
Geographe	Geographe_GE4_B_00003	5									
Geographe	Geographe_GE4_B_00005	0									
Geographe	Geographe_GE4_C_00001	5									
Geographe	Geographe_GE4_C_00002	0									
Geographe	Geographe_GE4_C_00003	0									
Geographe	Geographe_GE4_C_00005	0									
Hercules	Hercules_HE1_A_00002	20									
Hercules	Hercules_HE1_A_00003	0									
Hercules	Hercules_HE1_A_00004	35									
Hercules	Hercules_HE1_A_00005	0									
Hercules	Hercules_HE1_A_00006	35									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Hercules	Hercules_HE1_B_00001	45									
Hercules	Hercules_HE1_B_00002	35									
Hercules	Hercules_HE1_B_00004	15									
Hercules	Hercules_HE1_B_00005	5									
Hercules	Hercules_HE1_C_00001	5									
Hercules	Hercules_HE1_C_00002	20									
Hercules	Hercules_HE1_C_00005	25									
Hercules	Hercules_HE1_C_00006	30				1					
Hercules	Hercules_HE1_C_00007	30				1					
Hercules	Hercules_HE2_A_00001	30				1					
Hercules	Hercules_HE2_A_00002	5									
Hercules	Hercules_HE2_A_00003	30	1								
Hercules	Hercules_HE2_A_00004	5									
Hercules	Hercules_HE2_A_00005	60									
Hercules	Hercules_HE2_A_00006	25									
Hercules	Hercules_HE2_B_00002	60									
Hercules	Hercules_HE2_B_00004	80									
Hercules	Hercules_HE2_B_00005	25		1							
Hercules	Hercules_HE2_B_00006	75									
Hercules	Hercules_HE2_C_00002	5									
Hercules	Hercules_HE2_C_00003	25									
Hercules	Hercules_HE2_C_00004	20									
Hercules	Hercules_HE2_C_00007	20									
Hercules	Hercules_HE2_C_00009	25									
Hercules	Hercules_HE3_A_00001	50									
Hercules	Hercules_HE3_A_00003	45									
Hercules	Hercules_HE3_A_00005	40		1							
Hercules	Hercules_HE3_B_00001	30									
Hercules	Hercules_HE3_B_00002	40									
Hercules	Hercules_HE3_B_00004	15									
Hercules	Hercules_HE3_B_00005	25									
Hercules	Hercules_HE3_B_00006	30		1							
Hercules	Hercules_HE3_C_00001	5									
Hercules	Hercules_HE3_C_00002	40									
Hercules	Hercules_HE3_C_00003	0						1			
Hercules	Hercules_HE3_C_00005	35			1						
Hercules	Hercules_HE3_C_00007	0									
Hercules	Hercules_HE3_C_00008	5									
Hercules	Hercules_HE4_A_00001	5									
Hercules	Hercules_HE4_A_00002	25									
Hercules	Hercules_HE4_A_00004	15									
Hercules	Hercules_HE4_A_00005	0									
Hercules	Hercules_HE4_B_00001	30									
Hercules	Hercules_HE4_B_00003	15									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Hercules	Hercules_HE4_B_00004	40									
Hercules	Hercules_HE4_B_00005	15									
Hercules	Hercules_HE4_B_00008	15									
Hercules	Hercules_HE4_B_00009	20									
Hercules	Hercules_HE4_B_00010	25									
Hercules	Hercules_HE4_C_00001	30									
Hercules	Hercules_HE4_C_00002	0									
Hercules	Hercules_HE4_C_00003	0	1								
Hercules	Hercules_HE4_C_00004	20									
Hercules	Hercules_HE4_C_00005	5									
Hot Tap X	HotTap_HTX_HTX1R_A_00006	40									
Hot Tap X	HotTap_HTX_HTX1R_B_00004	25		1							
Hot Tap X	HotTap_HTX_HTX1R_B_00005	15									
Hot Tap X	HotTap_HTX_HTX1R_B_00007	50	1								
Hot Tap X	HotTap_HTX_HTX1R_C_00002	30	1								
Hot Tap X	HotTap_HTX_HTX1R_C_00003	45									
Hot Tap X	HotTap_HTX_HTX1R_C_00005	55									
Hot Tap X	HotTap_HTX_HTX1R_C_00006	50				1					
Hot Tap X	HotTap_HTX_HTX1R_C_00007	25									
Hot Tap Y	HotTap_HTY_HTY1R_A_00001	25				1					
Hot Tap Y	HotTap_HTY_HTY1R_A_00004	20									
Hot Tap Y	HotTap_HTY_HTY1R_A_00005	25									
Hot Tap Y	HotTap_HTY_HTY1R_A_00007	40					1				
Hot Tap Y	HotTap_HTY_HTY1R_A_00009	15									
Hot Tap Y	HotTap_HTY_HTY1R_A_00010	15									
Hot Tap Y	HotTap_HTY_HTY1R_A_00013	20									
Hot Tap Y	HotTap_HTY_HTY1R_A_00014	35									
Hot Tap Y	HotTap_HTY_HTY1R_B_00001	25		1							
Hot Tap Y	HotTap_HTY_HTY1R_B_00004	20									
Hot Tap Y	HotTap_HTY_HTY1R_B_00006	10		1							
Hot Tap Y	HotTap_HTY_HTY1R_B_00008	10		5							
Hot Tap Y	HotTap_HTY_HTY1R_B_00009	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00001	25									
Hot Tap Y	HotTap_HTY_HTY1R_C_00002	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00004	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00005	20									
Hot Tap Y	HotTap_HTY_HTY1R_C_00006	10									
La Bella	LaBella_LB1_A_00001	30		1							
La Bella	LaBella_LB1_A_00004	5									
La Bella	LaBella_LB1_A_00006	30									
La Bella	LaBella_LB1_B_00008	5									
La Bella	LaBella_LB1_B_00009	5									
La Bella	LaBella_LB1_B_00013	15									
La Bella	LaBella_LB1_C_00001	15									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
La Bella	LaBella_LB1_C_00003	15									
La Bella	LaBella_LB1_C_00004	20									
La Bella	LaBella_LB2_A_00014	15									
La Bella	LaBella_LB2_A_00017	10									
La Bella	LaBella_LB2_A_00021	0									
La Bella	LaBella_LB2_A_00024	10									
La Bella	LaBella_LB2_A_00026	0									
La Bella	LaBella_LB2_A_00028	0									
La Bella	LaBella_LB2_B_00029	35									
La Bella	LaBella_LB2_B_00030	20									
La Bella	LaBella_LB2_B_00033	20									
La Bella	LaBella_LB2_B_00035	15									
La Bella	LaBella_LB2_B_00036	25									
La Bella	LaBella_LB2_B_00040	5									
La Bella	LaBella_LB2_B_00041	5									
La Bella	LaBella_LB2_C_00043	5									
La Bella	LaBella_LB2_C_00044	5									
La Bella	LaBella_LB2_C_00045	0									
La Bella	LaBella_LB2_C_00047	0									
La Bella	LaBella_LB2_C_00048	5									
La Bella	LaBella_LB3_A_00001	5									
La Bella	LaBella_LB3_A_00003	0		1							
La Bella	LaBella_LB3_A_00005	5									
La Bella	LaBella_LB3_A_00007	5									
La Bella	LaBella_LB3_A_00009	5									
La Bella	LaBella_LB3_A_00010	0									
La Bella	LaBella_LB3_B_00002	5									
La Bella	LaBella_LB3_B_00004	5		1							
La Bella	LaBella_LB3_B_00006	5		1							
La Bella	LaBella_LB3_B_00007	5									
La Bella	LaBella_LB3_B_00009	0									
La Bella	LaBella_LB3_C_00002	5		1							
La Bella	LaBella_LB3_C_00003	5									
La Bella	LaBella_LB3_C_00005	5									
La Bella	LaBella_LB3_C_00007	0									
La Bella	LaBella_LB4_A_00001	0									
La Bella	LaBella_LB4_A_00003	0				1					
La Bella	LaBella_LB4_A_00005	5									
La Bella	LaBella_LB4_B_00004	5									
La Bella	LaBella_LB4_B_00005	0									
La Bella	LaBella_LB4_C_00001	0		1							
La Bella	LaBella_LB4_C_00004	0									
La Bella	LaBella_LB4_C_00005	5									
La Bella	LaBella_LB4_C_00006	0									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
La Bella	LaBella_LB4_D_00001	35									
La Bella	LaBella_LB4_D_00002	25									
La Bella	LaBella_LB4_D_00003	30									
La Bella	LaBella_LB4_D_00004	15									
La Bella	LaBella_LB4_D_00005	20									
La Bella	LaBella_LB4_D_00006	25									
La Bella	LaBella_LB4_D_00007	35									
La Bella	LaBella_LB4_D_00008	40		1							
LBGE	Routes_LBGE_LBGE3R_A_00001	40									
LBGE	Routes_LBGE_LBGE3R_A_00002	45		2							
LBGE	Routes_LBGE_LBGE3R_A_00004	5									
LBGE	Routes_LBGE_LBGE3R_A_00005	5									
LBGE	Routes_LBGE_LBGE3R_A_00006	15									
LBGE	Routes_LBGE_LBGE3R_A_00008	45		1							
LBGE	Routes_LBGE_LBGE3R_B_00001	15									
LBGE	Routes_LBGE_LBGE3R_B_00002	5									
LBGE	Routes_LBGE_LBGE3R_B_00003	0									
LBGE	Routes_LBGE_LBGE3R_B_00004	0									
LBGE	Routes_LBGE_LBGE3R_B_00005	10		1							
LBGE	Routes_LBGE_LBGE3R_C_00001	0									
LBGE	Routes_LBGE_LBGE3R_C_00002	0									
LBGE	Routes_LBGE_LBGE3R_C_00003	0									
LBGE	Routes_LBGE_LBGE3R_C_00004	0									
LBGE	Routes_LBGE_LBGE3R_C_00005	0									
LBGE	Routes_LBGE_LBGE6R_A_00002	0									
LBGE	Routes_LBGE_LBGE6R_A_00003	5									
LBGE	Routes_LBGE_LBGE6R_A_00004	0									
LBGE	Routes_LBGE_LBGE6R_A_00005	5				1					
LBGE	Routes_LBGE_LBGE6R_A_00006	0									
LBGE	Routes_LBGE_LBGE6R_B_00001	0									
LBGE	Routes_LBGE_LBGE6R_B_00003	5		1							
LBGE	Routes_LBGE_LBGE6R_B_00004	5									
LBGE	Routes_LBGE_LBGE6R_B_00005	0									
LBGE	Routes_LBGE_LBGE6R_C_00001	0									
LBGE	Routes_LBGE_LBGE6R_C_00002	0									
LBGE	Routes_LBGE_LBGE6R_C_00003	0									
LBGE	Routes_LBGE_LBGE6R_C_00004	0									
LBGE	Routes_LBGE_LBGE6R_C_00005	0									
Thylacine	Thylacine_TH1_A_00002	65									
Thylacine	Thylacine_TH1_A_00003	55						9			
Thylacine	Thylacine_TH1_A_00006	25									
Thylacine	Thylacine_TH1_A_00007	20						2		1	
Thylacine	Thylacine_TH1_A_00008	30						6			
Thylacine	Thylacine_TH1_A_00009	30						3			

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH1_B_00015	45						3			
Thylacine	Thylacine_TH1_B_00016	55						3			
Thylacine	Thylacine_TH1_B_00017	60						1			
Thylacine	Thylacine_TH1_B_00018	60						5			
Thylacine	Thylacine_TH1_B_00021	55						2			
Thylacine	Thylacine_TH1_B_00023	45									
Thylacine	Thylacine_TH1_C_00028	40									
Thylacine	Thylacine_TH1_C_00029	45						3			
Thylacine	Thylacine_TH1_C_00031	25						1			
Thylacine	Thylacine_TH1_C_00033	40						2			
Thylacine	Thylacine_TH2_A_00001	0									
Thylacine	Thylacine_TH2_A_00003	0									
Thylacine	Thylacine_TH2_A_00005	5									
Thylacine	Thylacine_TH2_A_00009	5									
Thylacine	Thylacine_TH2_B_00010	5									
Thylacine	Thylacine_TH2_B_00011	0									
Thylacine	Thylacine_TH2_B_00012	0									
Thylacine	Thylacine_TH2_B_00013	5	1								
Thylacine	Thylacine_TH2_B_00014	5									
Thylacine	Thylacine_TH2_C_00015	0									
Thylacine	Thylacine_TH2_C_00016	5									
Thylacine	Thylacine_TH2_C_00017	0									
Thylacine	Thylacine_TH2_C_00018	5		1							
Thylacine	Thylacine_TH2_C_00019	0									
Thylacine	Thylacine_TH2_C_00021	0									
Thylacine	Thylacine_TH3_A_00001	15		2							
Thylacine	Thylacine_TH3_A_00003	10									
Thylacine	Thylacine_TH3_A_00004	30						4			
Thylacine	Thylacine_TH3_A_00005	25									
Thylacine	Thylacine_TH3_A_00007	20		1				1			
Thylacine	Thylacine_TH3_A_00009	20		1							
Thylacine	Thylacine_TH3_A_00010	5									
Thylacine	Thylacine_TH3_A_00011	5		2							
Thylacine	Thylacine_TH3_A_00014	10		1							
Thylacine	Thylacine_TH3_B_00015	10									
Thylacine	Thylacine_TH3_B_00018	10									
Thylacine	Thylacine_TH3_B_00020	10						1			
Thylacine	Thylacine_TH3_B_00022	10									
Thylacine	Thylacine_TH3_C_00023	15						2			
Thylacine	Thylacine_TH3_C_00024	5					1				
Thylacine	Thylacine_TH3_C_00025	5									
Thylacine	Thylacine_TH3_C_00026	10					1				
Thylacine	Thylacine_TH3_C_00027	5									
Thylacine	Thylacine_TH3_C_00030	5									

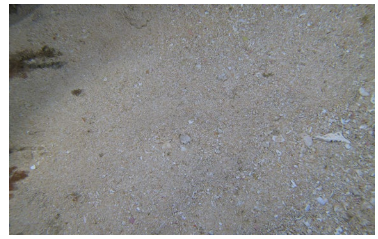
Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH3_C_00031	5									
Thylacine	Thylacine_TH3_C_00033	10									
Thylacine	Thylacine_TH4_A_00005	15						3			
Thylacine	Thylacine_TH4_A_00007	15						2			
Thylacine	Thylacine_TH4_A_00008	10						1			
Thylacine	Thylacine_TH4_A_00009	10						1			
Thylacine	Thylacine_TH4_A_00010	15									
Thylacine	Thylacine_TH4_A_00011	15						4			
Thylacine	Thylacine_TH4_B_00016	30						5			
Thylacine	Thylacine_TH4_B_00018	25									
Thylacine	Thylacine_TH4_B_00019	30						3			
Thylacine	Thylacine_TH4_B_00020	20						2			
Thylacine	Thylacine_TH4_B_00022	10									
Thylacine	Thylacine_TH4_C_00023	10									
Thylacine	Thylacine_TH4_C_00024	25						1			
Thylacine	Thylacine_TH4_C_00025	15									
Thylacine	Thylacine_TH4_C_00028	20						2			
Thylacine	Thylacine_TH4_C_00029	5									
Thylacine	Thylacine_TH4_C_00030	5									
Thylacine	Thylacine_TH4_C_00033	10									
Thylacine	Thylacine_TH5_00014	5									
Thylacine	Thylacine_TH6_00003	5									
Thylacine	Thylacine_TH6_00005	5									
Thylacine	Thylacine_TH6_00006	5									
Thylacine	Thylacine_TH6_00011	5									
Thylacine	Thylacine_TH6_00016	15									
Thylacine	Thylacine_TH7_00009	0									
Thylacine	Thylacine_TH7_00012(2)	5		1							
Thylacine	Thylacine_TH7_00013(2)	5									
Thylacine	Thylacine_TH7_00014(2)	5									
Thylacine	Thylacine_TH7_00015	0									
Thylacine	Thylacine_TH7_00017	0									
Thylacine	Thylacine_TH7_00018	0									
Thylacine	Thylacine_TH7_00022	0									
Thylacine	Thylacine_TH8_00009	5									
Thylacine	Thylacine_TH8_00011	5		1							
Thylacine	Thylacine_TH8_00013	5									
Thylacine	Thylacine_TH8_00015	10									
Thylacine	Thylacine_TH8_00019	5									
Thylacine	Thylacine_TH8_00021	5									
Thylacine	Thylacine_TH8_00022	5									
Thylacine	Thylacine_TH8_00025	0									
Thylacine	Thylacine_TH8_00027	5									
Thylacine	Thylacine_TH8_00028	5									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH8_00030	5									

APPENDIX 6
EXAMPLE SEABED PHOTOGRAPHS

Artisan – AR4

Artisan – AR4



Geographe – GE2

Geographe – GE4

Hercules – HE1

Hercules – HE3

La Bella – LB2

La Bella – LB4 Extra DC

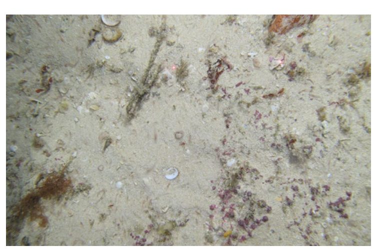
Thylacine – TH2

Thylacine – TH4

Thylacine – TH6

Thylacine – TH8

Hot Tap – HTX – HTX1R



Hot Tap – HTX – HTX1R

Hot Tap – HTY – HTY1R


Hot Tap – HTY – HTY1R


Routes – ARGE – ARGE3R


Routes – ARGE – ARGE6R


Routes – ARGE – ARGE7R


Routes – ARHTX – ARHTX1R

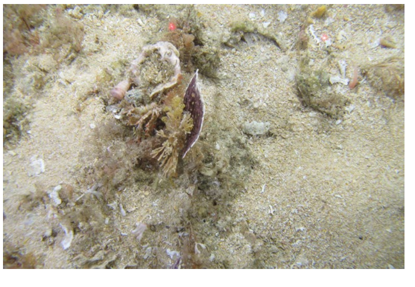

Routes – ARHTX – ARHTX1R


Routes – ARHTY – ARHTY1R


Routes – ARHTY – ARHTY1R


Routes – ARLB – ARLB2R


Routes – ARLB – ARLB6R


Routes – LBGE – LBGE3R


Routes – LBGE – LBGE6R

Appendix F Jasco Modelling Report

Otway Offshore Project – Drilling Program

Assessing Marine Fauna Sound Exposures

Submitted to:

Phil Wymess
Beach Energy Limited
Contract: BE00028888

Authors:

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Disclaimer:

The results presented herein are relevant within the specific context described in this report. They could be misinterpreted if not considered in the light of all the information contained in this report. Accordingly, if information from this report is used in documents released to the public or to regulatory bodies, such documents must clearly cite the original report, which shall be made readily available to the recipients in integral and unedited form.

Contents

Figures

Tables

Executive Summary

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with the Beach Energy Otway Development program. The modelling study considers specific components of the program at two representative wells, Artisan-1 and Thylacine North-1. These two wells were selected for consideration as they represent the two different seabed types and different depths within the region of the project.

The study considers the drilling activities of an anchored Mobile Offshore Drilling Unit (MODU), and an associated Offshore Support Vessel (OSV) conducting re-supply of the MODU under dynamic positioning (DP) and standing by near the MODU, and combinations of these scenarios.

The modelling study specifically assessed distances from operations where underwater sound levels reached thresholds corresponding to various levels of potential impact to marine fauna. The animals considered here included marine mammals, turtles, and fish (including fish eggs and larvae). Due to the variety of species considered, there are several different thresholds for evaluating effects, including: mortality, injury, temporary reduction in hearing sensitivity, and behavioural disturbance.

The modelling methodology considered MODU and vessel specific source levels and range-dependent environmental properties. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), and as accumulated sound exposure levels (SEL, L_E) as appropriate for non-impulsive (continuous) noise sources. The key results of this acoustic modelling study are summarised below.

Marine mammals

- The results for the NMFS (2018) criteria applied for marine mammal PTS and TTS for MODU and vessel operations are assessed for 8 scenarios, each encompassing a day of operations (a 24 h period). PTS is only predicted to occur in either low- or high-frequency cetaceans, and unlikely to occur at distances greater that 40 m from any of the considered sources. The maximum distance predicted for TTS onset in low-frequency cetaceans is 2.73 km from any of the considered sources.
- The SEL_{24h} is a cumulative metric that reflects the dosimetric impact of noise levels within 24 hours based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. The corresponding SEL_{24h} radii represent an unlikely worst-case scenario. More realistically, marine mammals (as well as fish and turtles) would not stay in the same location for 24 hours. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with impairment (either PTS or TTS) if it remained in that location for 24 hours.
- The maximum distances to the NOAA (2019) marine mammal behavioural response criterion of 120 dB re 1 µPa (SPL) are presented in Table 1 for each scenario considered. The distances to this isopleth are calculated in relation to the centroid of all sources within the scenario as indicated in the provided SPL maps.

Table 1. Maximum distances (km) to marine mammal behavioural response threshold (NOAA 2019) for all considered scenarios.

SPL (L_p; dB re 1 µPa)	MODU	OSV standby	MODU and OSV resupply	MODU and OSV standby
Thylacine North-1				
120	4.6	4.44	13.7	6.72
Artisan-1				
120	5.91	6.23	17.4	8.94

Turtles

Considering the Finneran et al. (2017) criteria for turtle PTS and TTS for MODU and vessels, assessed here for each scenario, both PTS and TTS are not predicted to occur within the modelling resolution.

Fish

Sound produced by the MODU and/or vessel operations reach the sound levels associated with recoverable injury, and TTS for some fish species in close proximity to the sound sources (within 30 or 90 m respectively), but in order for the thresholds to be exceeded, the fish must remain at those distances for either 12 or 48h.

1. Introduction

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with the Beach Energy Otway Development program (Figure 1). The modelling study considers specific components of the program at two representative wells, Artisan-1 and Thylacine North-1. The study considers the drilling activities of an anchored Mobile Offshore Drilling Unit (MODU) conducting drilling operations, and an associated Offshore Support Vessel (OSV), conducting re-supply of the MODU under dynamic positioning (DP) and standing by near the MODU, and combinations of these scenarios.

The modelling study specifically assessed distances from operations where underwater sound levels reached thresholds corresponding to various levels of impact to marine fauna. The animals considered here included marine mammals (cetaceans and pinnipeds), turtles, and fish (including fish eggs and larvae). Due to the variety of species considered, there are several different thresholds for evaluating effects, including: mortality, injury, temporary reduction in hearing sensitivity, and behavioural disturbance.

The modelling methodology considered MODU and vessel specific source levels and range-dependent environmental properties. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), and accumulated sound exposure levels (SEL, L_E), as appropriate for non-impulsive (continuous) noise sources.

Section 2 explains the metrics used to represent underwater acoustic fields and the impact criteria considered. Section 3 details the methodology for predicting the source levels and modelling the sound propagation, including the specifications of the vessel sources and all environmental parameters the propagation models required. Section 4 presents the results, which are then discussed and summarised in Section 5.

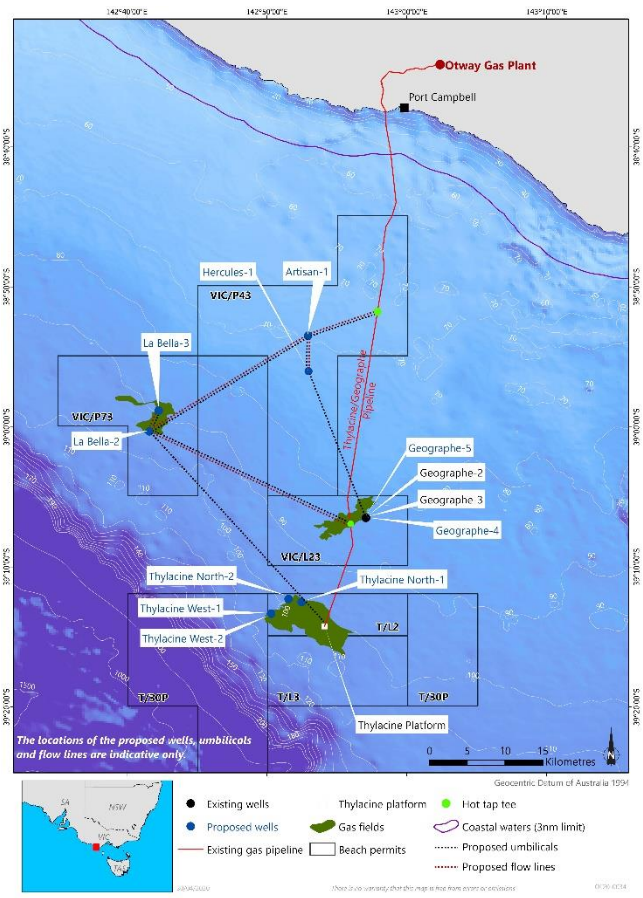

Figure 1. Otway Offshore Project Locations and Proposed Petroleum Safety Zones.

1.1. Acoustic Modelling Scenario Details

The two wells, Artisan-1 and Thylacine North-1 were selected to represent the two different seabed types in the region, and the range of depths across the Project. While both wells are located on the continental shelf, the deeper Thylacine North-1 area has a seabed characterised by well-cemented carbonate caprock (calcarenite), overlying semi-cemented carbonate rock (calcarenite). This contrasts with the shallower Artisan-1 area, which is characterised by a thin veneer of coarse sand/gravel overlying semi-cemented carbonate rock. The Thylacine North-1 location is considered representative of all wells at Thylacine, Geographe and La Bella, while Artisan-1 will also represent Hercules (Figure 1).

The study considers four scenarios at each of the two well, Artisan-1 and Thylacine North-1, Figure 2, for 8 scenarios in total. The scenarios are described in Table 2, with the modelling site locations and descriptions provided in Table 3.

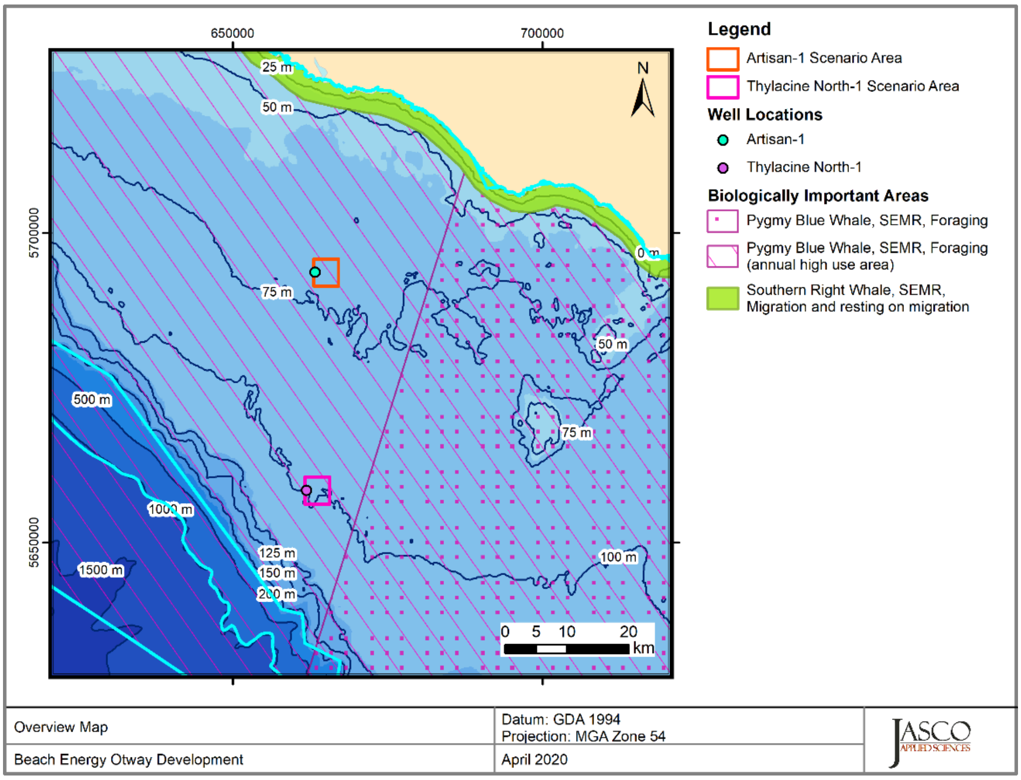

Figure 2. Overview of the modelled area and local features.

The first scenarios (Scenarios 1 and 5; Table 2) represents the operation of a representative MODU proposed for the project (Section 3.3.1). The platform is assumed to be drilling continuously, while at anchor. Scenarios 2–4 and 6–8 represent the operation of a representative OSV Anchor Handling Tug Supply (AHTS) vessel (Section 3.3.2). In Scenarios 2 and 6, the OSV is standing by within 1–3 km of the MODU, ready to respond as required. During this time, the vessel is assumed to be operating under a mix of slow transit, minimal power DP and drifting, and has been conservatively estimated to operating at 15% of the vessels Maximum Continuous Rating (MCR).

To assess the cumulative sound field over a 24 h period, an indicative area (2 km wide × 4 km long) in which the OSV could be during standby was defined at each modelled well, as shown in Figures 3 and 4. Within the defined area, the vessel was considered to be at randomly seeded locations to best approximate real world activities, and thus approximate representative sound fields for activities (see Figures 3 – 4).

Scenarios 3 and 7 combines the operation of the MODU with the OSV during resupply operations. During a 24 h period the resupply operations consist of the following vessel locations and movements:

- OSV transiting within the standby area, operating at 15% MCR,

- OSV in transit from the standby area to the MODU, operating at 15% MRC (4 knots),
- OSV under DP alongside the MODU for a period of 4 hours, operating at 20% MRC,
- OSV in transit from the MODU to the standby area, operating at 15% MRC (4 knots).

Scenarios 4 and 8 combine the operation of the MODU with the OSV keeping station in the defined area over 24 h, representing drilling operations with typical support vessel activity.

Table 2. Description of modelling scenarios

Well	Scenario Number	Description	Associated Modelled Sites
Thylacine North-1	1	MODU, normal drilling operations	1
	2	OSV standby at 15% MCR, independent of MODU, for 24 h	3
	3	MODU with OSV during resupply operations (including 4 hours alongside the MODU)	1, 2 and 3
	4	MODU with OSV standby at 15% MCR (combination of Scenarios 1 and 2)	1 and 3
Artisan-1	5	MODU, normal drilling operations	4
	6	OSV standby at 15% MRC, independent of MODU, for 24 h	6
	7	MODU with OSV during resupply operations (including 4 hours alongside the MODU)	4, 5 and 6
	8	MODU with OSV standby at 15% MCR (combination of Scenarios 5 and 6)	4 and 6

Table 3. Location details for the modelled sites.

Well	Site	Source	Latitude (S)	Longitude (E)	MGA Zone 54 (GDA94)		Water depth (m)
					X (m)	*Y* (m)	
Thylacine North-1	1	MODU	39° 12' 30.6000"	142° 52' 29.7600"	661882	5658411	99.1
	2	OSV	39° 12' 30.5914"	142° 52' 32.4231"	661946	5658410	99.1
	3	OSV standby	39° 12' 29.3412"	142° 53' 53.1042"	663882	5658408	99.1
Artisan-1	4	MODU	38° 53' 27.4106"	142° 52' 58.4450"	663300	5693640	71.5
	5	OSV	38° 53' 27.4021"	142° 53' 01.0962"	663364	5693639	71.6
	6	OSV standby	38° 53' 26.1553"	142° 54'21.4165"	665300	5693637	70.2

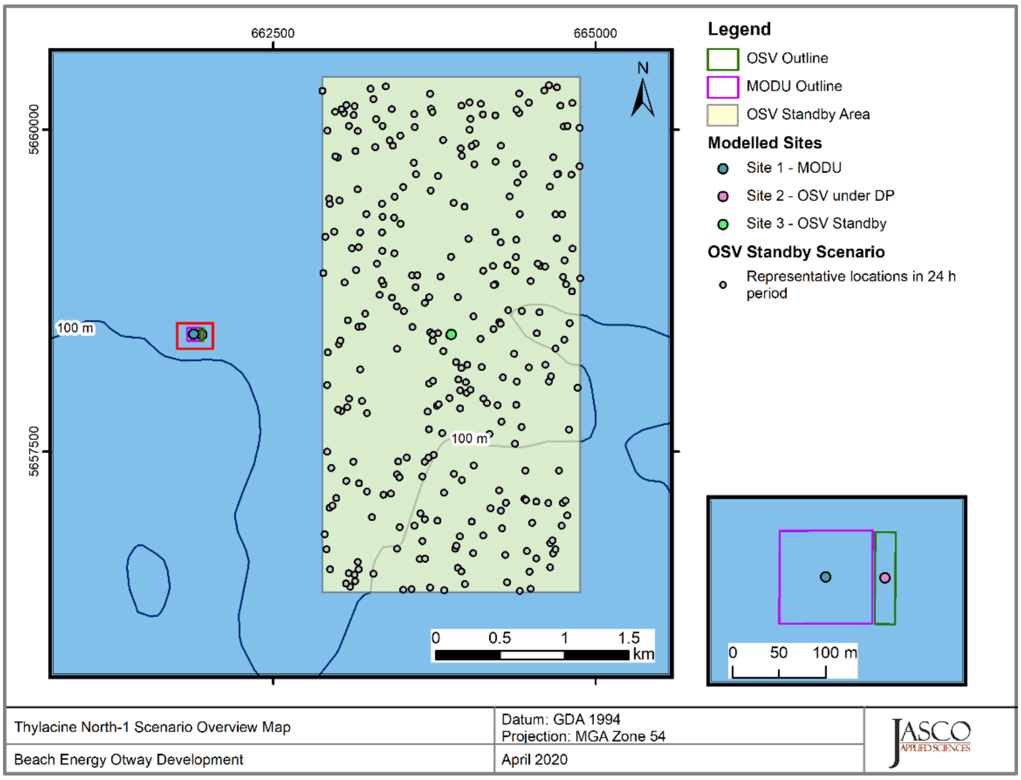

Figure 3. Overview of the modelled sites and the random representative locations for the Thylacine North-1 well.

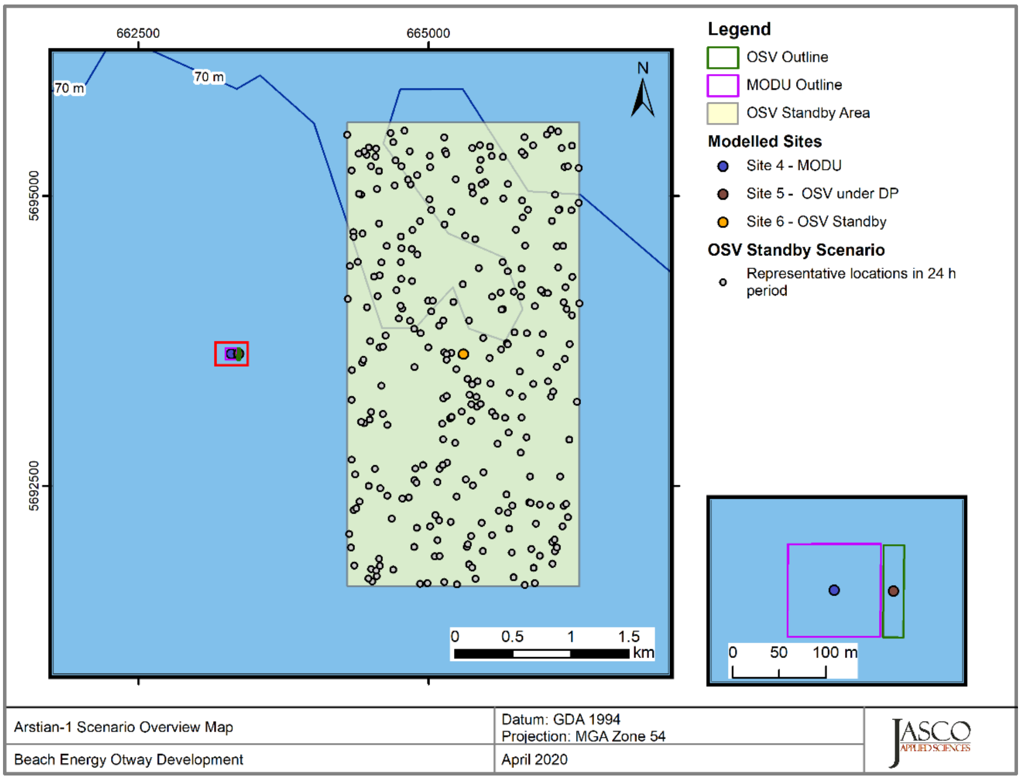

Figure 4. Overview of the modelled sites and the random representative locations for the Artisan-1 well.

2. Noise Effect Criteria

To assess the potential impacts of a sound-producing activity, it is necessary to first establish exposure criteria (thresholds) for which sound levels may be expected to have a negative impact on animals. Whether acoustic exposure levels might injure or disturb marine fauna is an active research topic. Since 2007, several expert groups have developed SEL-based assessment approaches for evaluating auditory injury, with key works including Southall et al. (2007), Finneran and Jenkins (2012), Popper et al. (2014), United States National Marine Fisheries Service (NMFS 2018) and Southall et al. (2019). The number of studies that investigate the level of behavioural disturbance to marine fauna by anthropogenic sound has also increased substantially.

Several sound level metrics, such as PK, SPL, and SEL, are commonly used to evaluate noise and its effects on marine life (Appendix A). In this report, the duration of the SEL accumulation is defined as Integrated over a 24 h time period.

Appropriate subscripts indicate any applied frequency weighting applied (Appendix A.3). The acoustic metrics in this report reflect the updated ANSI and ISO standards for acoustic terminology, ANSI S1.1 (R2013) and ISO 18405:2017 (2017).

This study applies the following noise criteria (Sections 2.1–2.2 and Appendix A.2), chosen for their acceptance by regulatory agencies and because they represent current best available science:

1. Frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from the U.S. National Oceanic and Atmospheric Administration (NOAA) Technical Guidance (NMFS 2018) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in marine mammals for non-impulsive sources.
2. Marine mammal behavioural threshold based on the current interim U.S. National Oceanic and Atmospheric Administration (NOAA) (2019) criterion for marine mammals of 120 dB re 1 µPa (SPL; L_p) for non-impulsive sound sources.
3. Sound exposure guidelines for fish, fish eggs, and larvae (Popper et al. 2014).
4. Frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in turtles for non-impulsive sources.

2.1. Marine Mammals

The criteria applied in this study to assess possible effects of vessel noise on marine mammals are summarised in Tables 4 and detailed in Sections 2.1.1 and 2.1.2, with frequency weighting explained in Appendix A.3.

Table 4. Acoustic effects of continuous noise on marine mammals: Unweighted SPL and SEL_{24h} thresholds.

Hearing group	NOAA (2019)	NMFS (2018)	
	Behaviour	PTS onset thresholds (received level)	TTS onset thresholds (received level)
	SPL (L_p; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)
LF cetaceans	120	199	179
HF cetaceans		198	178
VHF cetaceans		173	153
Phocid Seals		201	181
Otariid Seals		219	199

L_p denotes sound pressure level period and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24 h period and has a reference value of 1 µPa²s.

2.1.1. Behavioural response

The NMFS non-pulsed noise criterion was selected for this assessment because it represents the most commonly applied behavioural response criterion by regulators. The distances at which behavioural responses could occur were therefore determined to occur in areas ensonified above an unweighted SPL of 120 dB re 1 µPa (NOAA 2019). Appendix A.2 provides more information about the development of this criteria.

2.1.2. Injury and hearing sensitivity changes

There are two categories of auditory threshold shifts or hearing loss: permanent threshold shift (PTS), a physical injury to an animal's hearing organs; and Temporary Threshold Shift (TTS), a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued.

To assist in assessing the potential for injuries to marine mammals, this report applies the criteria recommended by NMFS (2018), considering both PTS and TTS, to help assess the potential for injuries to marine mammals (Table 4). Appendix A.2 provides more information about the NMFS (2018) criteria.

2.2. Fish, Turtles, Fish Eggs, and Fish Larvae

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to continue developing noise exposure criteria for fish and turtles, work begun by a NOAA panel two years earlier. The Working Group developed guidelines with specific thresholds for different levels of effects for several species groups (Popper et al. 2014). The guidelines define quantitative thresholds for three types of immediate effects:

- Mortality, including injury leading to death,
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma, and
- TTS.

Masking and behavioural effects can be assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds. However, as these depend upon activity-based subjective ranges, these effects are not addressed in this report and are included in Table 5 for completeness only. Because the presence or absence of a swim bladder has a role in hearing, fish's susceptibility to injury from noise exposure depends on the species and the presence and possible role of a swim bladder in hearing. Thus, different thresholds were proposed for fish without a swim bladder (also appropriate for sharks and applied to whale sharks in the absence of other information), fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing. Turtles, fish eggs, and fish larvae are considered separately.

Table 5 lists the relevant effects thresholds from Popper et al. (2014) for shipping and continuous noise. 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 (Scholik and Yan 2002, Amoser and Ladich 2003, Smith et al. 2006); this is reflected in the SPL thresholds for fish with a swim bladder involved in hearing.

Finneran et al. (2017) presented revised thresholds for turtle injury, considering frequency weighted SEL, which have been applied in this study for vessels (Table 6).

Table 5. Criteria for vessel noise exposure for fish, adapted from Popper et al. (2014).

Type of animal	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 h	158 dB SPL for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Turtles	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Sound pressure level dB re 1 µPa.
Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

Table 6. Acoustic effects of continuous noise on turtles, weighted SEL_{24h}, Finneran et al. (2017).

PTS onset thresholds* (received level)	TTS onset thresholds* (received level)
220	200

L_E denotes cumulative sound exposure over a 24 h period and has a reference value of 1 µPa^{2}s.

3. Methods and Parameters

The operations considered in this study will take place within the Beach Energy Otway Development project area, at depths 70–99 m (Appendix D.2.1). Activities could take place at any time in the year. The most conservative water sound speed profile (i.e., the profile leading to the longest acoustic propagation) was therefore selected for modelling (Appendix D.2.2). In the project area, the seabed consists of a sequence of cemented and semi-cemented calcareous sediments (Appendix D.2.3), with a thin veneer of gravel at the seabed in some locations.

This section described the methods used to characterise the vessels sound fields, including the acoustic propagation models, the frequency ranges and the accumulation periods considered.

3.1. Geometry and Modelled Regions

JASCO's Marine Operations Noise Model (MONM-BELLHOP Appendix C.2) was used to predict the underwater acoustic propagation loss from modelled sites (Table 3), at frequencies of 10 Hz to 25 kHz. This model considers the environmental variations along the propagation path. The final acoustic fields combine the MODU or the OSV source levels (Section 3.3) with the site-specific propagation loss fields.

To assess sound levels with MONM-BELLHOP, the sound field modelling calculated propagation losses up to distances of 75 km from the source in each cardinal direction, with a horizontal separation of 10 m between receiver points along the modelled radials. The sound fields were modelled with a horizontal angular resolution of $\Delta\theta = 2.5°$ for a total of $N = 144$ radial planes. Receiver depths were chosen to span the entire water column over the modelled areas, from 1 m to a maximum of 4250 m, with step sizes that increased with depth. To supplement the MONM results, high-frequency results for propagation loss were modelled using BELLHOP for frequencies from 2.5 to 25 kHz. The MONM and BELLHOP results were combined to produce results for the full frequency range of interest.

To produce the maps of received sound level distributions, isopleths and calculate distances to specified sound level thresholds, the maximum-over-depth level was calculated at each sampling point within the modelled region. The radial grids of maximum-over-depth levels for resampled (by linear triangulation) to produce a regular Cartesian grid. The sound field grids from all sources were summed (Equation A-5) to produce the cumulative sound field grid with cell sizes of 25 m. The contours and threshold ranges were calculated from these flat Cartesian projections of the modelled acoustic fields.

3.2. Accumulated SEL

The MODU and the OSV continuously produce sound. The reported source levels are usually in terms of sound pressure levels (SPL), representing the average instantaneous acoustic level of the MODU or the OSV during specific operation. The evaluation of the cumulative sound field (i.e. in terms of SEL over 24 h) depends on the number of seconds of operation during the accumulation period.

As the MODU is considered stationary and continuously operational (Scenario 1 and 5), 1-second SEL, equivalent to SPL, were increased by $10 \log_{10}(T)$, where T is 86,400 (the number of seconds in 24 h).

During standby (Scenarios 2,4 and 6,8), the OSV would not be stationary but transiting the station-keeping corridor at low speed. In this case, the cumulative sound field was modelled by translating the modelled sound field at the centre of the corridor (Sites 3 and 6; Table 3) to randomly-selected locations within the corridor. The sound field was translated from SPL to SEL based on the time spent at each location, and the translated fields were added to modelled 24 h of standby. Here, 288 locations were selected, representing a location every 5 minutes for 24 hours; Figures 3 and 4 present the random locations at each well.

During resupply operations, (Scenarios 3 and 7), the vessel movements were similar to the movements for the standby scenarios, with the additional contributions of the transit to and from the standby area to the MODU and the OSV under DP during resupply. The accumulated sound field during transit to and from the standby area to the MODU, was calculated by translating the single site modelled sound field at the centre of the corridor along a 2 km path from the centre of the station-keeping area to a location adjacent to the MODU. The accumulated SEL at locations along this path were integrated every 5 minutes (Equation A-5) based on transit speed of 4 knots. While on DP the 1-second SEL for the OSV at 20% MCR were increased by $10^{*}\log_{10}(T)$, where T is 14,400 (the number of seconds in 4 h).

3.3. Acoustic Sources

3.3.1. Mobile Offshore Drilling Unit (MODU)

The MODU, or semi-submersible platform, considered in this study is the Ocean Onyx as it represents the type of MODU that would be used for the wells (Figure 5). While in operation, it will be held in position via anchors and chains, as opposed to using thrusters. Underwater sound from the platform while drilling is expected to originate primarily from onboard equipment vibrations, while a smaller portion of the sound is expected to be transmitted directly into the water via the vibrating drill (Austin et al. 2018). Since the dominant vibration sources (e.g. pumps, generators, and machinery) are located on or below the main deck of the platform, the modelled depth of the point source representing the MODU was set to 11 m, approximately half the draft of the Ocean Onyx (22.7 m).

The estimate of the Ocean Onyx source level spectrum was based on the Transocean Polar Pioneer, a similarly sized MODU. The Polar Pioneer was measured by JASCO while anchored and drilling, and had a broadband (10 Hz to 35 kHz) source level of 178.7 dB re 1 µPa m (Austin et al. 2018). The decidecade source levels for the Polar Pioneer, used to represent an MODU, are shown in Figure 6.

Figure 5. *Ocean Onyx* semi-submersible platform.

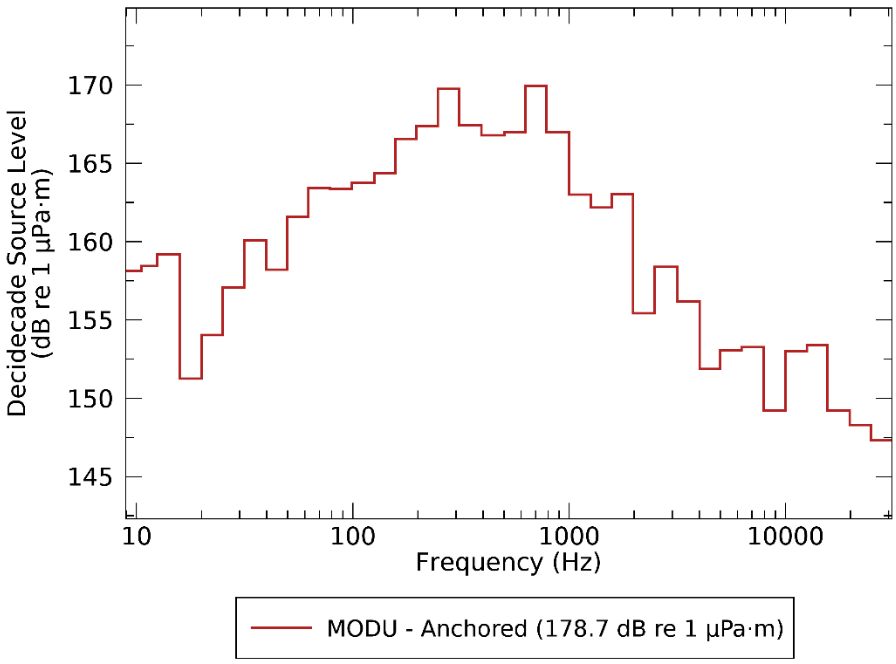

Figure 6. *MODU*: Decidecade source level spectrum.

Offshore Support Vessel (OSV)

Underwater sound that radiates from vessels is produced mainly by propeller and thruster cavitation, with a smaller fraction of noise produced by sound transmitted through the hull, such as by engines, gearing, and other mechanical systems. Sound levels tend to be the highest when thrusters are used to position the vessel and when the vessel is transiting at high speeds. A vessel's sound signature depends on the vessel's size, power output, propulsion system (e.g., conventional propellers vs. Voith Schneider propulsion), and the design characteristics of the given system (e.g., blade shape and size). A vessel produces broadband acoustic energy with most of the energy emitted below a few kilohertz. Sound from onboard machinery, particularly sound below 200 Hz, dominates the sound spectrum before cavitation begins (Spence et al. 2007).

The estimates of the source levels for the OSV were based on the Siem Offshore VS491 CD design Anchor Handling Tug Supply (AHTS) vessels (Figure 7). These vessels have a bollard pull of 285-310 t, and an overall length, beam and draft of 91.0, 22.0 and 7.95 m respectively.

The main propulsion system comprises two Wärtsilä Lips Controllable Pitch Propellers (CPP). Each LIPS CPP has the following parameters:

- 4.2 m propeller diameter
- 144 rpm nominal propeller speed, and
- 9215 kW maximum continuous power input.

In addition to the main propellers, the OSV is also equipped with a single bow azimuth thruster rated at 830 kW with the following parameters:

- Assumed 1.65 m propeller diameter
- 364 rpm nominal propeller speed, and
- 830 kW maximum continuous power input.

Furthermore, the OSV also feature two bow tunnel thrusters rated at 1000 kW each and two stern tunnel thrusters rated at 880 kW each, these tunnel thrusters are unlikely to be used in normal operations, however they could potentially be engaged if the OSVs have to hold station.

Source spectra for the main propellers and bow azimuth thruster were determined by the method described in Appendix B. Source spectra for the bow and stern thrusters were based on those of the Damen platform supply vessel 3300CD, which was used in previous studies (Zykov 2016). For the Damen 3300CD, the tunnel thrusters are 735 kW maximum continuous power input, hence the spectra were offset according to Equation 1.

Estimates of the acoustic source levels for the OSV were based on the parameters of the propulsion system, and the percentage MCR at which the vessel is expected to be operating at during each scenario, confirmed with the vessel manufacturer (Siem Offshore) and their vessel masters. In cases where the modelled source levels were derived from the source levels of other vessels, the modelled source levels were adjusted using Equation 1.

$$\mathrm{SL} = \mathrm{SL}_{\mathrm{ref}} + 10\log_{10}\left(\frac{P}{P_{\mathrm{ref}}}\right) \tag{1}$$

Here the modelled source level (SL) is estimated from the source level of the proxy source (SL_{ref}) and the propulsion powers of the modelled and proxy sources (P and P_{ref}, respectively).

The depths of the source sources were based on the approximate location of cavitation. During transit, since the main propellers will be the primary propulsion system used, the modelled source depth was set to 4.5 m, which is based on a draft of 7.95 m and propeller size on 4.2 m (Leggat et al. 1981). While using DP, the primary propulsion system will be bow and stern thrusters; in the case, the source was modelled at a depth of 6.5 m, based on a 1.65 m propeller diameter.

Figure 7. Photo of a Siem Anchor Handling Tug Supply (AHTS) vessel (Siem Offshore 2010).

The full power source spectrum was determined by summing the spectra for the individual thrusters and main propellers, and the spectrum for each modelling scenario was determined by offsetting the full power spectrum by $10\log_{10}(\mathrm{MCR})$, where the MCR is represented as a fraction of full power for each scenario. All thrusters have been included in the source level calculation for scenarios where the OSV was under DP. Only the main propulsion system was considered for scenarios where the vessel was transiting. The overall source levels are shown in Figure 8. An overall source level of 183.0 dB re 1 µPa m was used for transit in the standby area and 186.6 dB re 1 µPa m was used for re-supply operations when the OSV was under DP.

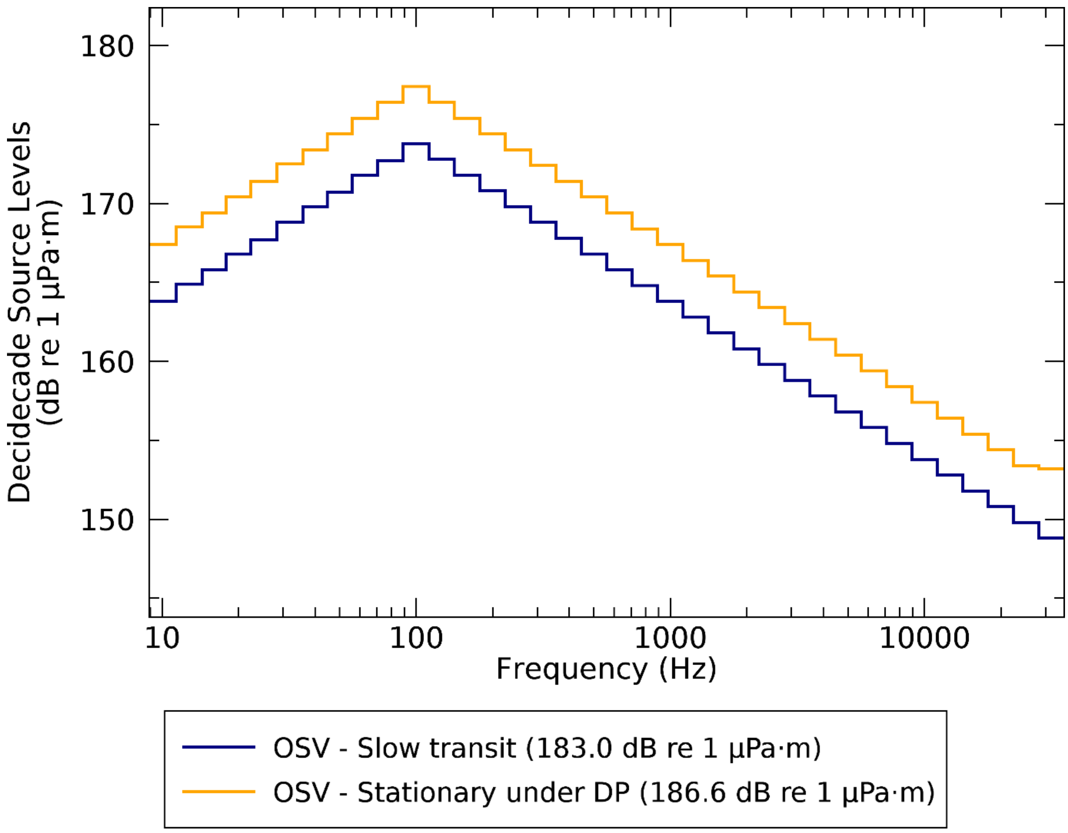

Figure 8. *OSV*: Decidecade source level spectra of the two modelled OSV MCR percentages, slow transit (15%) and DP (20%).

4. Results

The maximum-over-depth sound fields for the 8 modelled scenarios (described in Section 1.1) are presented below in two formats: as tables of distances to sound levels and, where the distances are long enough, as contour maps showing the directivity and range to various sound levels. Tables 7 and 8 present the maximum and 95% distances (defined in Appendix D.1) to SPL thresholds for the Thylacine North-1 and Artisan-1 well locations respectively. The ensonified areas for the marine mammal behavioural response criteria are provided in Table 9. Tables 10 and 11 represent the distances to frequency-weighted SEL_{24h} threshold, as well as total ensonified area.

Distances to isopleths/thresholds were reported from either the centroid of several sources or from the most dominant single source. When an isopleth completely envelopes multiple sources the centroid was used. When several closed isopleths exist the most dominant source was used.

4.1. Tabulated results

Table 7. *Thylacine North-1*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenario (see table footnotes). A dash indicates the threshold is not reached within the limits of the modelling resolution (25 m).

SPL (L_p; dB re 1 µPa)	MODU (Scenario 1)		OSV standby (Scenario 2)		MODU and OSV resupply (Scenario 3)[A]		MODU and OSV standby (Scenario 4)[B]	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–
170*	–	–	–	–	–	–	–	–
160	–	–	–	–	0.06	0.06	–	–
158#	–	–	–	–	0.08	0.08	–	–
150	0.03	0.03	0.05	0.05	0.29	0.26	0.03	0.03
140	0.19	0.19	0.32	0.31	1.15	1.09	0.19	0.19
130	0.97	0.9	1.38	1.28	4.28	3.83	2.41	2.12
120†	4.6	4.17	4.44	4.02	13.7	11.8	6.72	5.85
110	21.1	16.8	14.8	11.7	49.9	38.2	25.0	20.4
100	70.7	56.8	47.8	35.6	70.7	57.4	71.4	57.0

* 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).
# 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).
† Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).
A Radial distance reported from the mid-point between the MODU and the OSV on DP in resupply operations
B Radial distances for isopleths/thresholds that envelope the MODU and OSV were reported from the mid-point between the MODU and the centre of the OSV standby area. Otherwise radial distances reported from the centre of standby area.

Table 8. *Artisan-1*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenario (see table footnotes).A dash indicates the level was not reached within the limits of the modelling resolution (25 m). A slash indicates that $R_{95\%}$ is not reported when the R_{max} is greater than the maximum modelling extent.

SPL (L_p; dB re 1 µPa)	MODU (Scenario 5)		OSV standby (Scenario 6)		MODU and OSV resupply (Scenario 3)[A]		MODU and OSV standby (Scenario 4)[B]	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	0.03	0.03	–	–
170*	–	–	–	–	0.03	0.03	–	–
160	–	–	–	–	0.06	0.06	–	–
158#	–	–	–	–	0.09	0.09	–	–
150	0.04	0.04	0.05	0.05	0.33	0.31	0.05	0.05
140	0.21	0.20	0.37	0.36	1.6	1.53	0.37	0.36
130	1.19	1.09	1.89	1.81	5.89	5.41	3.22	2.82
120†	5.91	5.39	6.23	5.69	17.4	15.4	8.94	7.89
110	34.9	22.6	19.0	15.3	60.1	48.5	36.8	28.0
100	>75.0	/	56.0	46.4	>75.0	/	>75.0	/

* 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).
# 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).
† Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).
A Radial distance reported from the mid-point between the MODU and the OSV on DP in resupply operations
B Radial distances for isopleths/thresholds that envelope the MODU and OSV were reported from the mid-point between the MODU and the centre of the OSV standby area. Otherwise radial distances reported from the centre of standby area.

Table 9. *SPL*: Areas (km^2) for modelled scenarios within isopleths corresponding to the threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

SPL (L_p; dB re 1 µPa)	MODU	OSV standby	MODU and OSV resupply	MODU and OSV standby
Thylacine North-1				
120†	48.9	52.5	444	110
Artisan-1				
120†	94.3	105	764	202

† Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

Table 10. Thylacine North-1: Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (25 m).

Hearing group	SEL_{24h} Threshold ($L_{E,24h}$; dB re 1 µPa^2·s) #	MODU (Scenario 1)		OSV standby (Scenario 2)		MODU and OSV resupply (Scenario 3[B])		MODU and OSV standby (Scenario 4[B])	
		R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)
PTS									
LF cetaceans	199	0.03	0.004	–	–	0.03	0.004	0.03	0.004
MF cetaceans	198	–	–	–	–	–	–	–	–
HF cetaceans	173	0.04	0.006	–	–	0.04	0.006	0.04	0.006
Phocid Seals	201	–	–	–	–	–	–	–	–
Otariid Seals	219	–	–	–	–	–	–	–	–
Turtles	220	–	–	–	–	–	–	–	–
TTS									
LF cetaceans	179	0.84	1.54	1.03	4.48	2.66[C]	9.85	2.68[C]	9.58
MF cetaceans	178	0.03	0.003	–	–	0.03	0.003	0.03	0.003
HF cetaceans	153	0.6	1.09	1.03	4.35	2.68[C]	6.07	1.03[A]	4.35
Phocid Seals	181	0.14	0.063	–	–	0.14	0.063	0.14	0.063
Otariid Seals	199	–	–	–	–	–	–	–	–
Turtles	200	–	–	–	–	–	–	–	–

Frequency weighted.
[A] Radial distance reported from the centre of the OSV standby area.
[B] Radial distance reported from the centre of the MODU, unless indicated otherwise.
[C] Radial distance reported from the mid-point between the MODU and the centre of the OSV standby area.

Table 11. *Artisan-1*: Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (25 m).

Hearing group	SEL_{24h} Threshold ($L_{E,24h}$; dB re 1 µPa²·s) #	MODU (Scenario 5)		OSV standby (Scenario 6)		MODU and OSV resupply (Scenario 7)[B]		MODU and OSV standby (Scenario 8)[B]	
		R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)	R_{max} (km)	*Area* (km^2)
PTS									
LF cetaceans	199	–	–	–	–	–	–	–	–
MF cetaceans	198	–	–	–	–	–	–	–	–
HF cetaceans	173	0.04	0.005	–	–	0.04	0.005	0.04	0.005
Phocid Seals	201	–	–	–	–	–	–	–	–
Otariid Seals	219	–	–	–	–	–	–	–	–
Turtles	220	–	–	–	–	–	–	–	–
TTS									
LF cetaceans	179	0.92	2.49	1.12	8.21	2.73[C]	15.5	2.76[C]	13.9
MF cetaceans	178	–	–	–	–	–	–	–	–
HF cetaceans	153	0.60	1.09	1.04	4.23	2.68[C]	6.05	1.04[A]	4.23
Phocid Seals	181	0.21	0.11	–	–	0.21	0.11	0.21	0.11
Otariid Seals	199	–	–	–	–	–	–	–	–
Turtles	200	–	–	–	–	–	–	–	–

Frequency weighted.
[A] Radial distance reported from the centre of the OSV standby area.
[B] Radial distance reported from the centre of the MODU, unless indicated otherwise.
[C] Radial distance reported from the mid-point between the MODU and the centre of the OSV standby area.

4.2. Sound Field Maps

Maps of the estimated sound fields, threshold contours, and isopleths of interest for SPL and SEL_{24h} sound fields have been presented for the eight vessel modelling scenarios (Table 2) in Figures 9–24.

4.2.1. Thylacine North-1 Well Scenarios

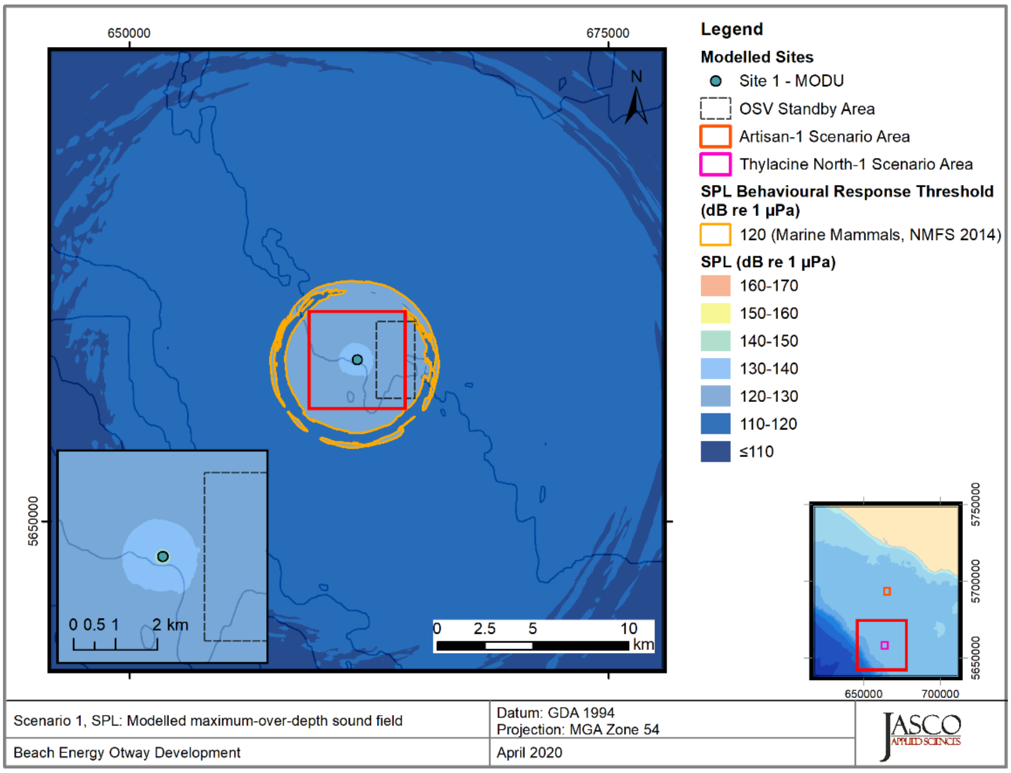

Figure 9. Thylacine North-1, *MODU (Scenario 1), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

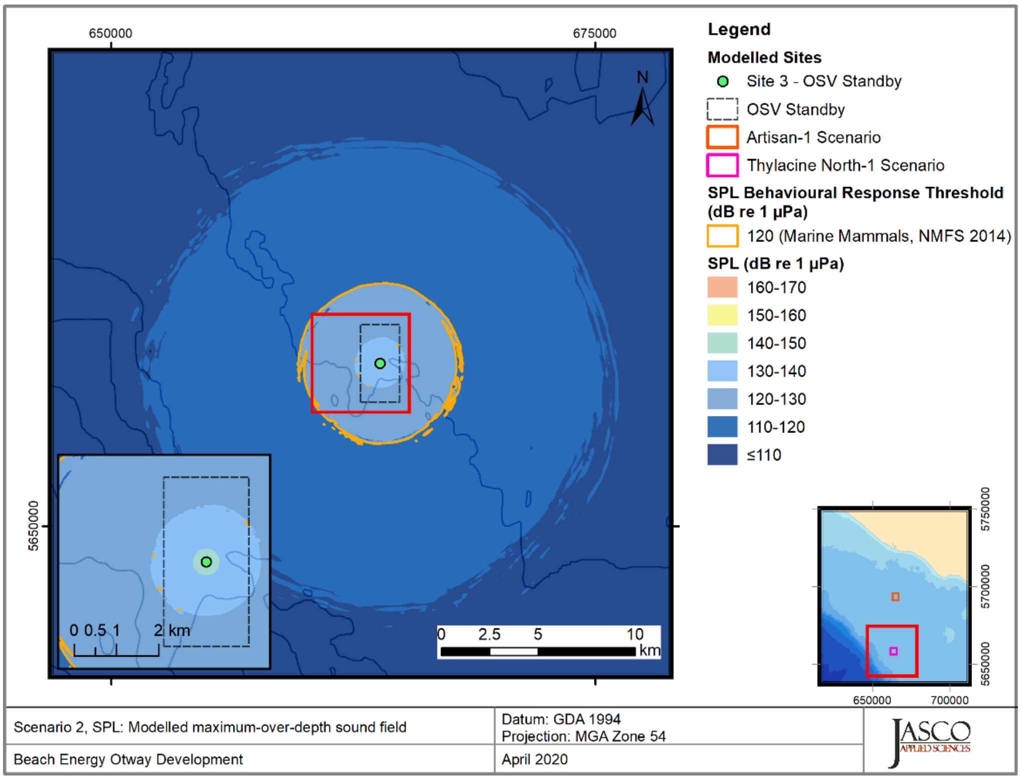

Figure 10. Thylacine North-1*, OSV standby (Scenario 2), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

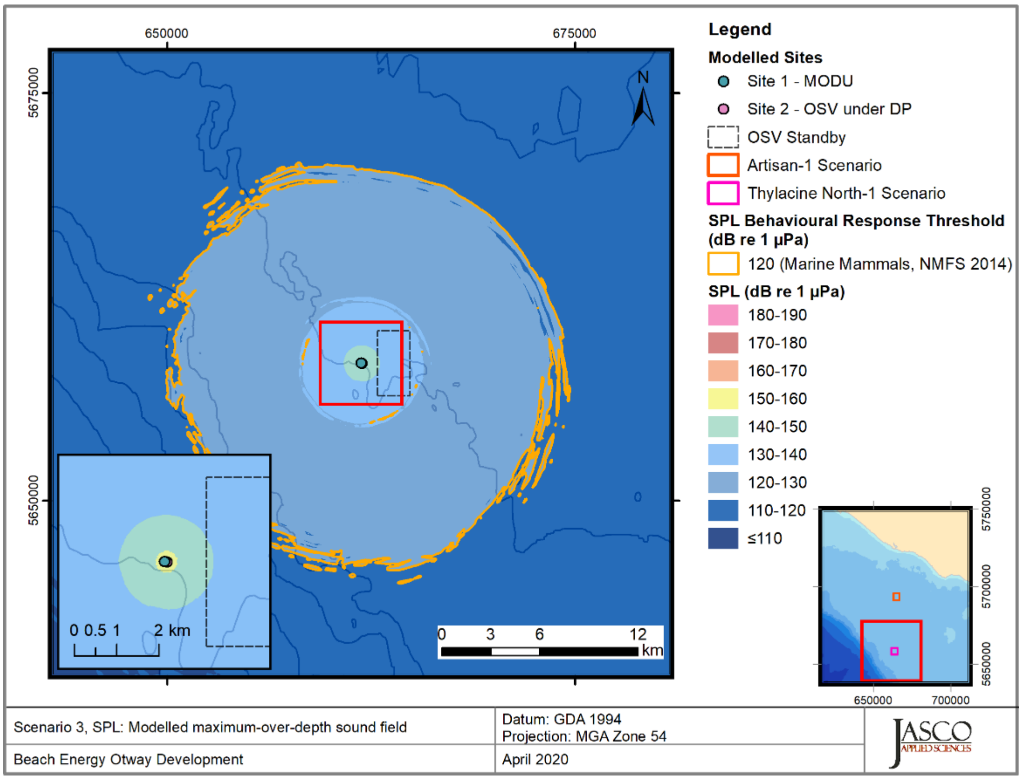

Figure 11. Thylacine North-1*, MODU and resupply OSV on DP (Scenario 3) SPL*: Sound level contour map, showing unweighted maximum-over-depth SPLresults. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

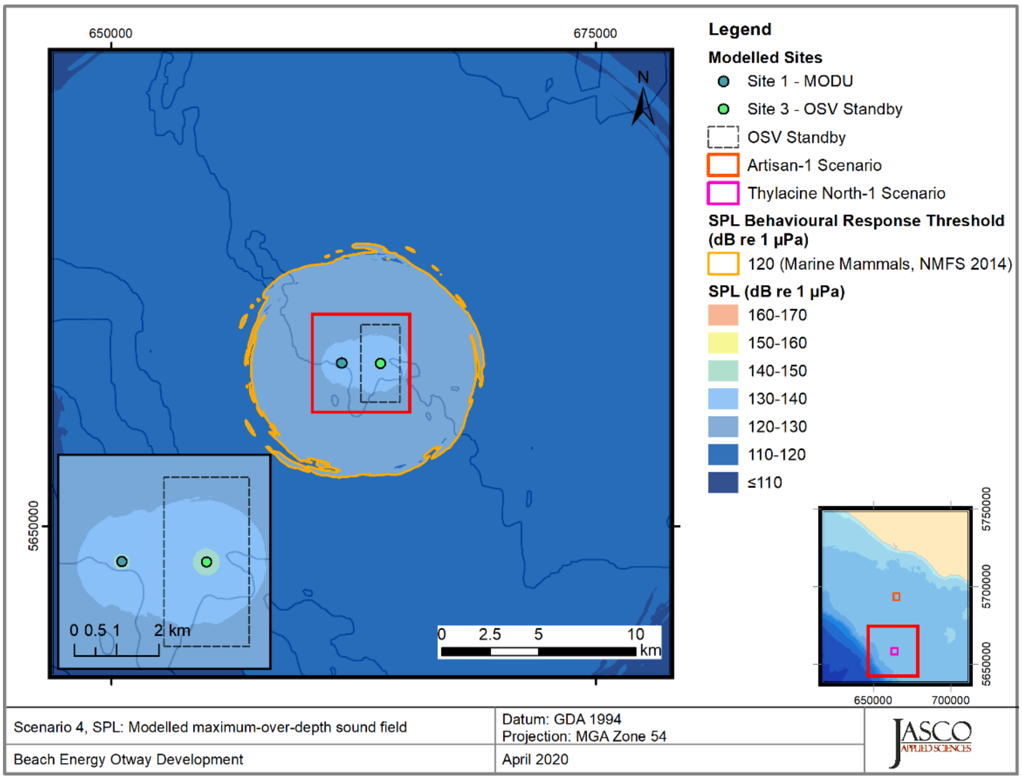

Figure 12. Thylacine North-1, *MODU and OSV standby (Scenario 4), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPLresults. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

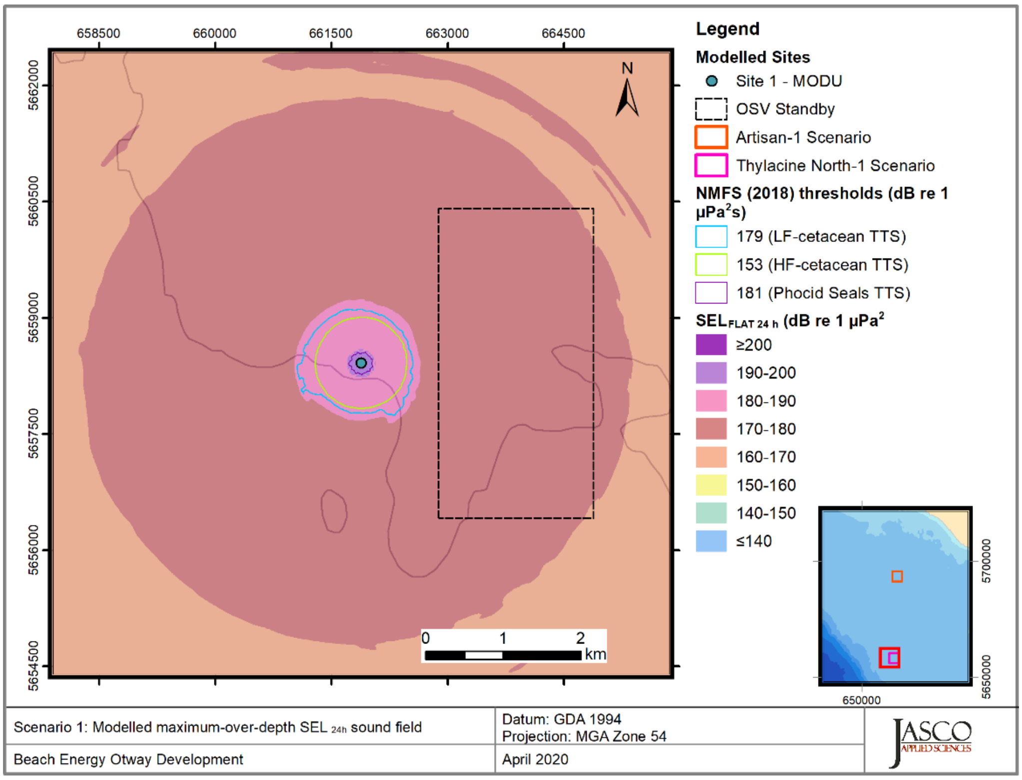

Figure 13. Thylacine North-1, *MODU (Scenario 1), SEL24h*: Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

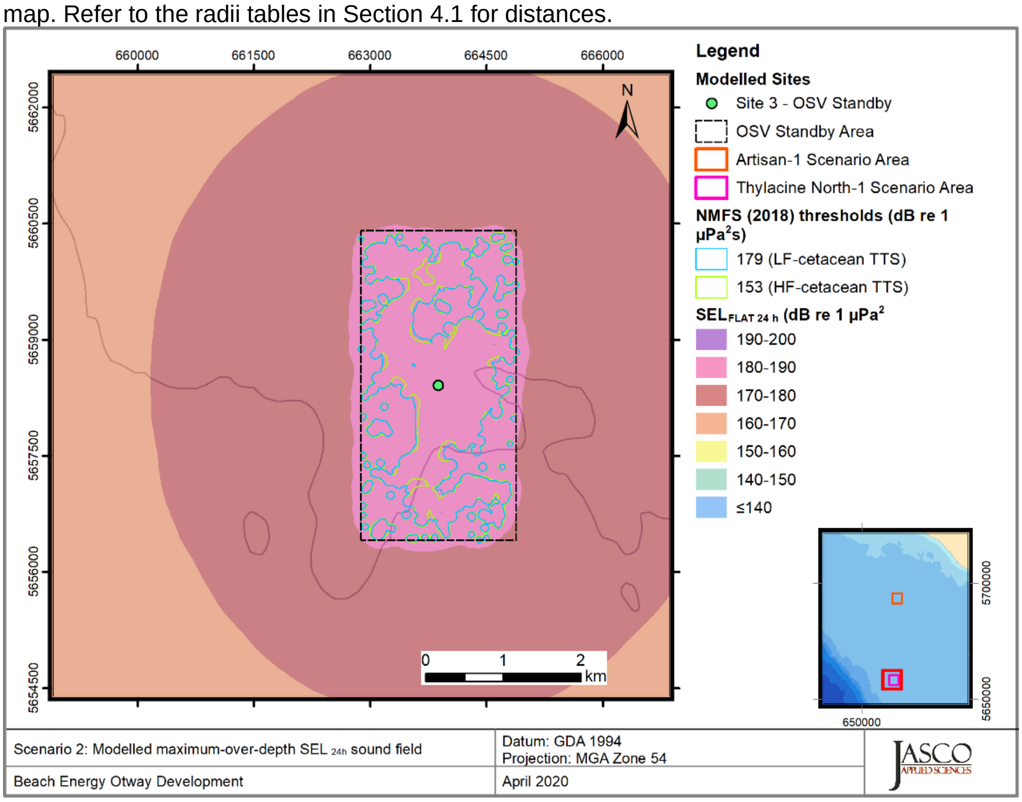

Figure 14. Thylacine North-1, *OSV standby (Scenario 2), SEL24h*: Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

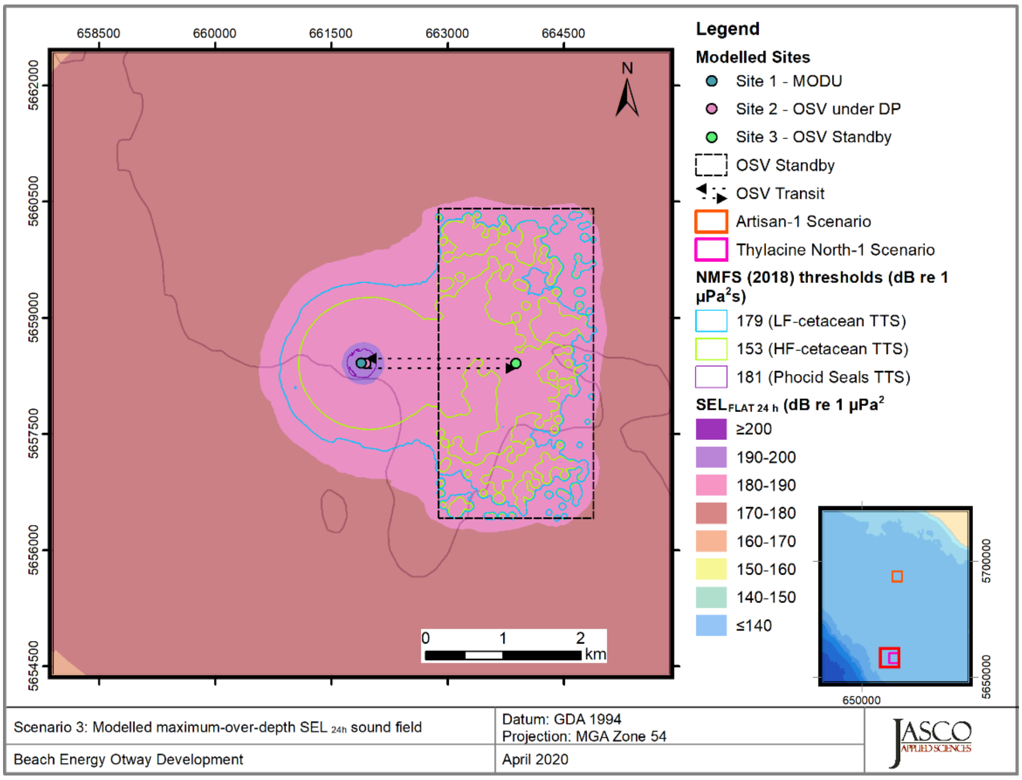

Figure 15. Thylacine North-1, *MODU and OSV on DP (Scenario 3), SEL24h*: Sound level contour map showing unweighted maximum-over-depth SEL24h results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

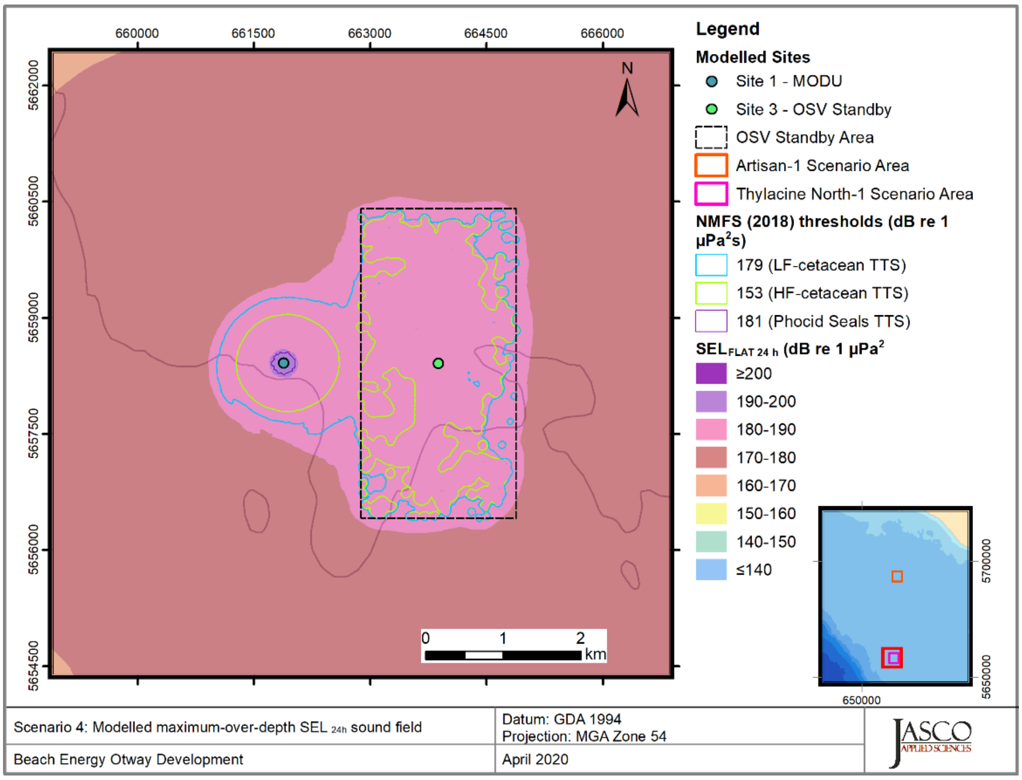

Figure 16. Thylacine North-1, *MODU and OSV standby (Scenario 4), SEL24h*: Sound level contour map showing unweighted maximum-over-depth SEL24h results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

4.2.2. Artisan-1 Well Scenarios

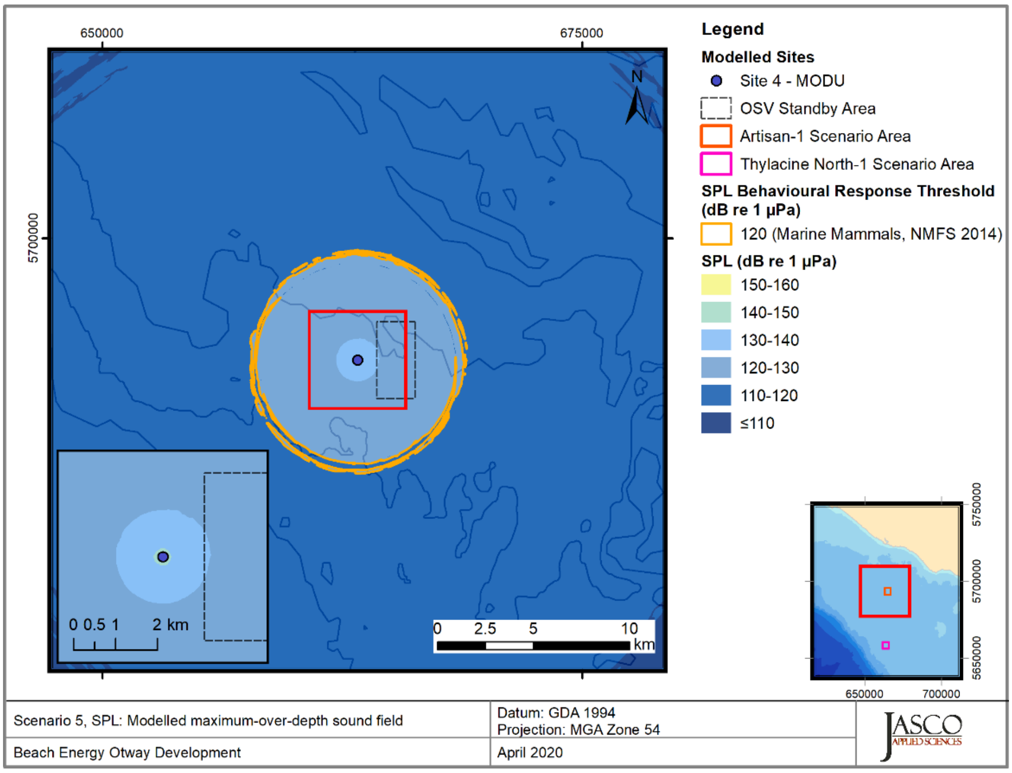

Figure 17. Artisan-1, *MODU (Scenario 5), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

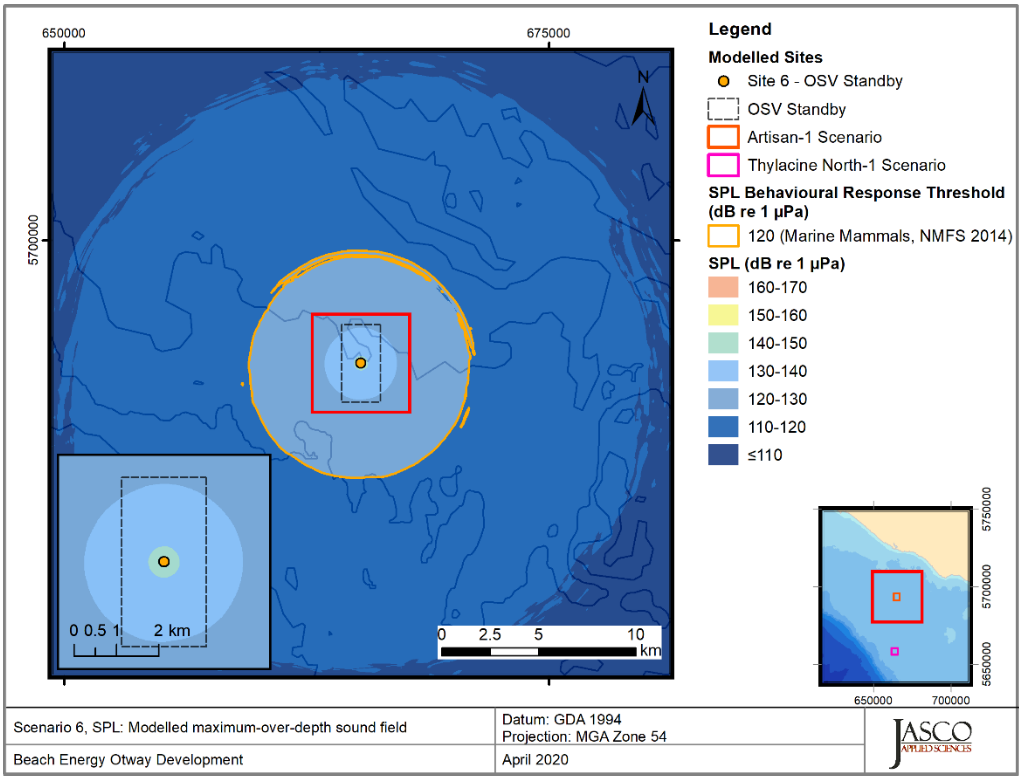

Figure 18. Artisan-1, *OSV standby (Scenario 6), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

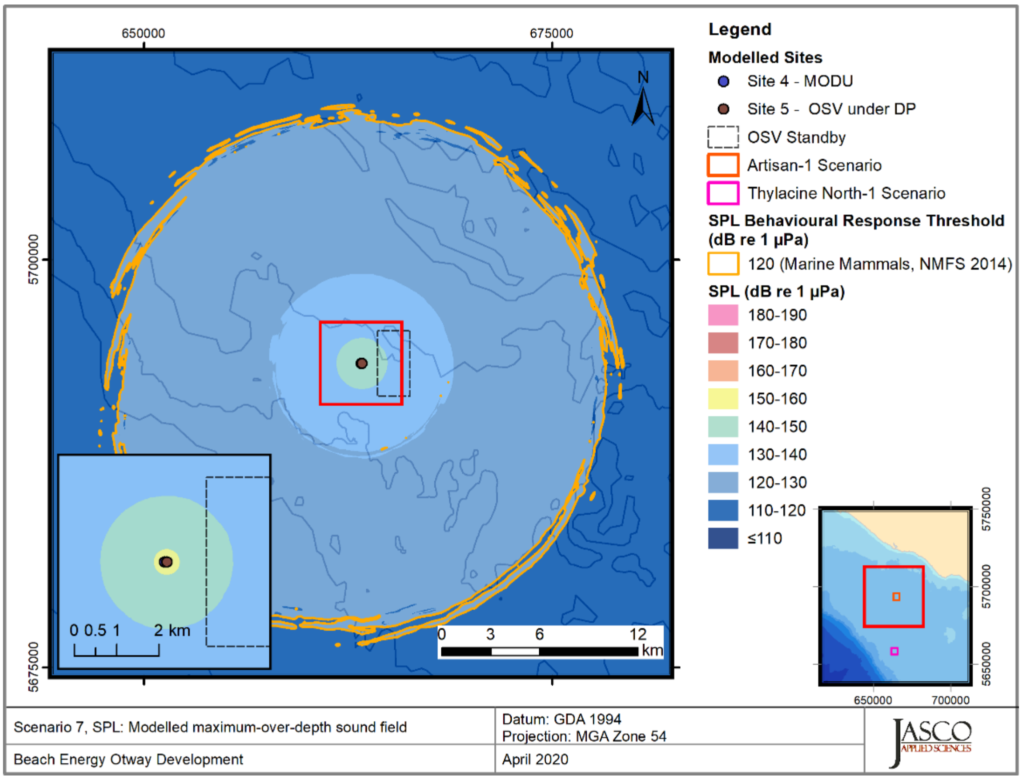

Figure 19. Artisan-1, *MODU and OSV on DP (Scenario 7), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPLresults. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

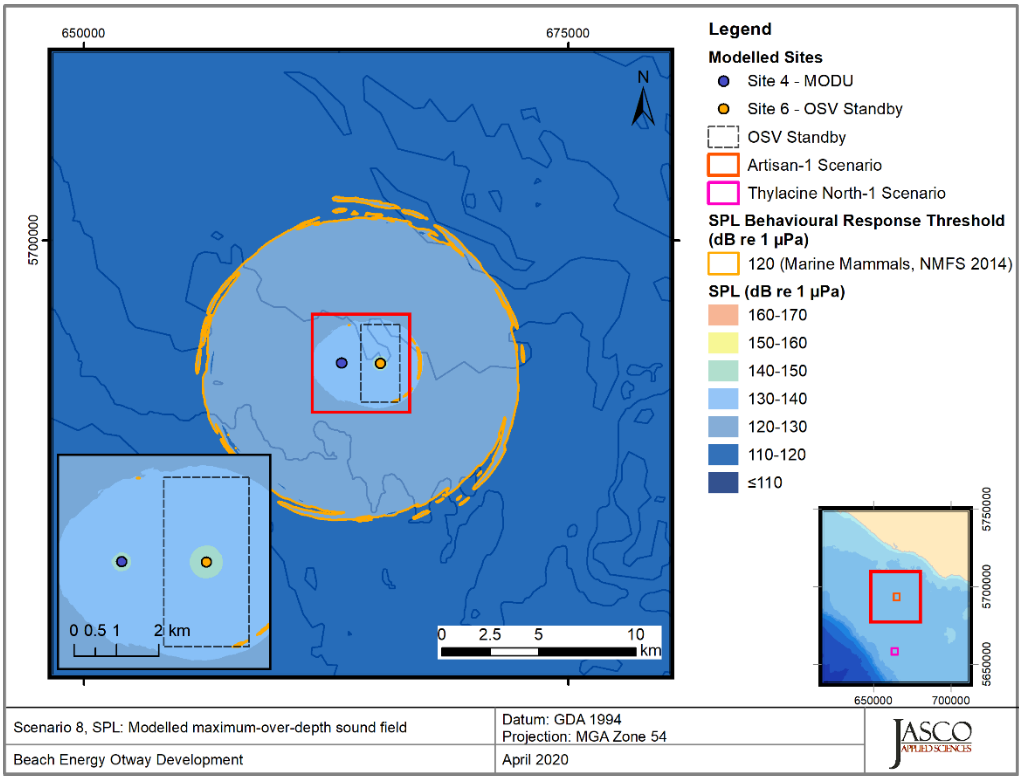

Figure 20. Artisan-1, *MODU and OSV standby (Scenario 8), SPL*: Sound level contour map, showing unweighted maximum-over-depth SPLresults. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

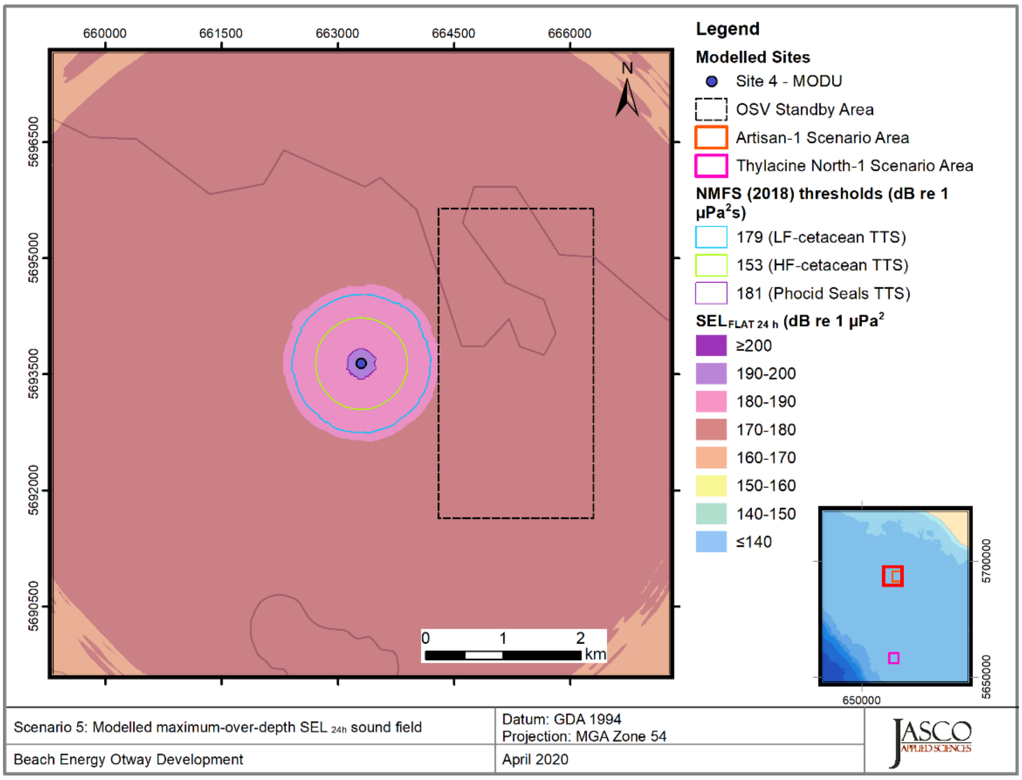

Figure 21. Artisan-1, *MODU (Scenario 5), SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

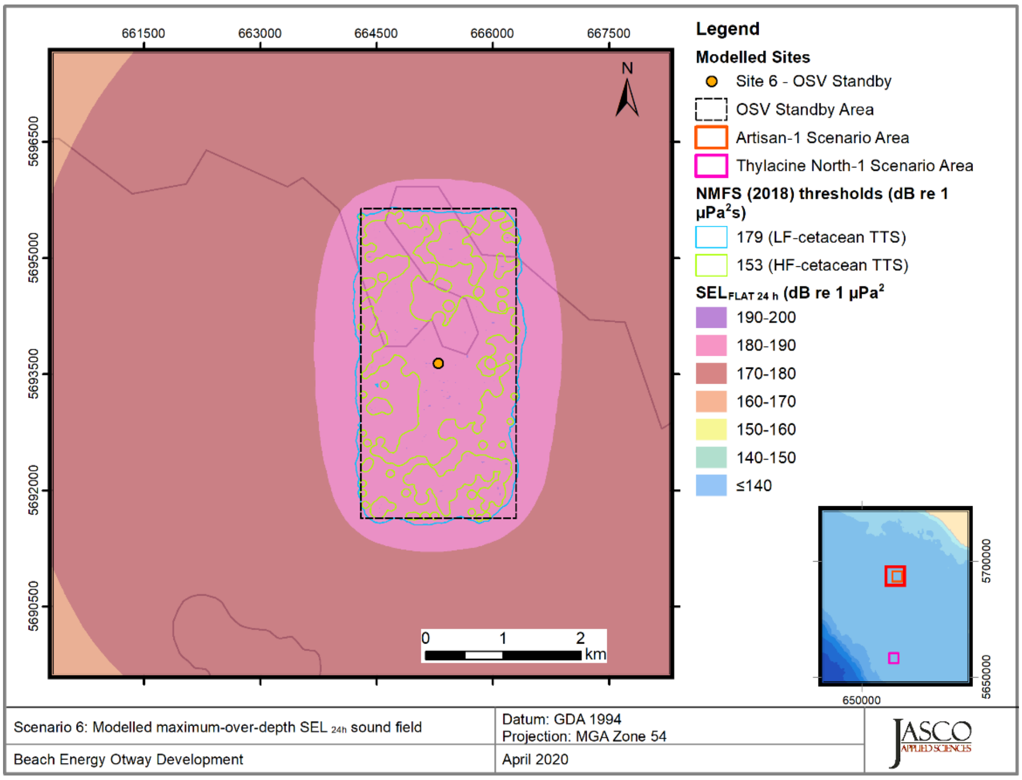

Figure 22. Artisan-1, *OSV on DP (Scenario 6), SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

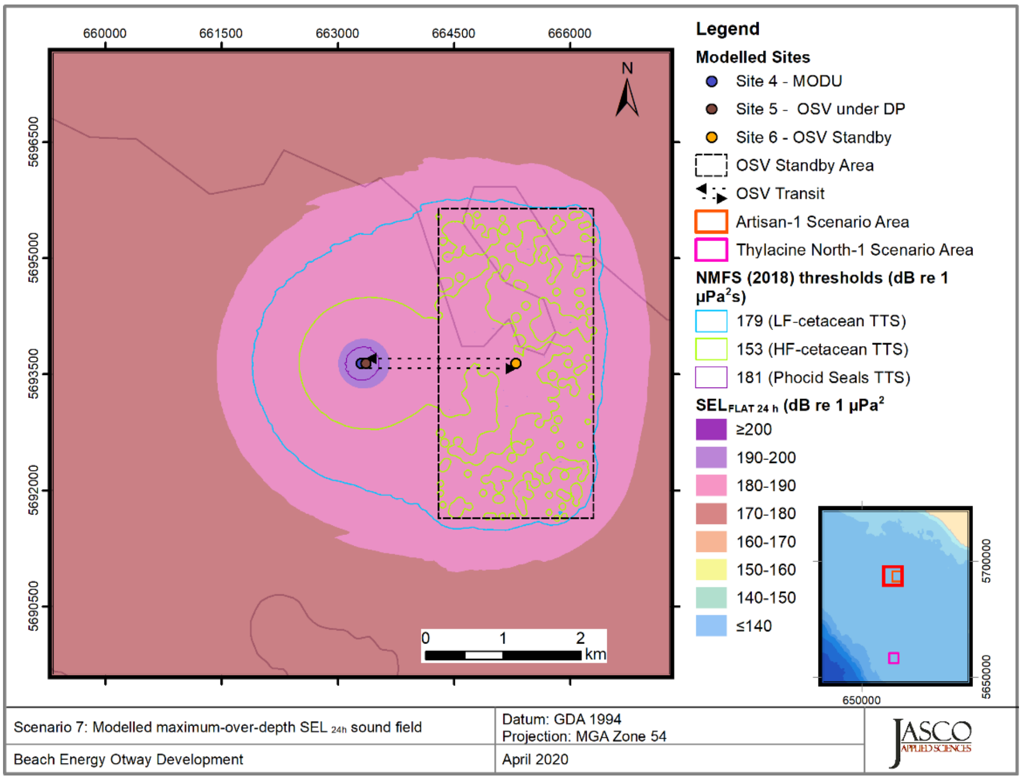

Figure 23. Artisan-1, *OSV standby (Scenario 7), SEL*$_{24h}$: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

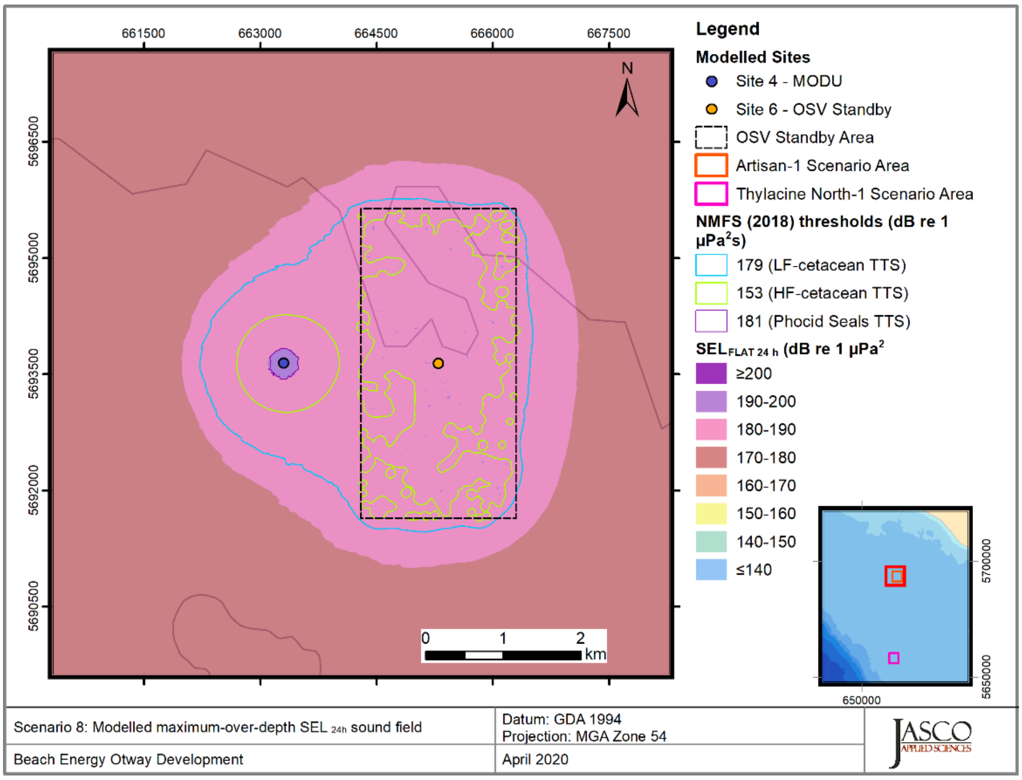

Figure 24. Artisan-1, *MODU and OSV on DP (Scenario 8), SEL*$_{24h}$: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholdsThresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map. Refer to the radii tables in Section 4.1 for distances.

5. Discussion and Summary

5.1. Noise emissions and acoustic propagation

The sound speed profile (Appendix D.2.2) was derived from data from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). The month of June was chosen based on an analysis of the temperature, salinity and sound speed profiles extracted from this database. The final profile consisted of two profile representative profiles select within the modelled area to capture propagation effects associated with shallow and deep-water regimes.

The considered sound speed profile was primarily downward refracting apart from a slight upward refracting layer, which extended approximately 40 m down from the sea surface. This layer has the potential to trap high frequency energy near the sea surface that would otherwise dissipate more rapidly in range due to propagation, absorption, and seabed losses. The slight upward refracting layer in the sound speed profile only has the potential to effective trap frequencies above 741 Hz based on the thickness of the refracting layer (Jensen et al. 2011).

Considering both well locations are situated on the continental shelf, variations in bathymetry were generally gradual within the modelled areas. Any variations in the bathymetry had a small effect on the predicted sound field footprints as manifested in the generally symmetric sound field footprints. However, the composition of the seabed used for modelling had a more substantial influence when comparing the threshold radii and sound field footprints between the Thylacine North-1 and Artisan-1 modelled areas. The presence of a thin veneer of un-consolidated gravel overlying semi-cemented carbonate rock led to a marginally more reflective seabed and likely led to large isopleths for low level thresholds. This is most evident for the marine mammal behavioural threshold of 120 dB re 1 µPa (SPL) for non-impulsive sound sources, where the Artisan-1 radii and areas are larger than Thylacine North-1 radii and areas.

For the results tables present in Section 4.1 were a dash is used in place of a horizontal distance, these thresholds may or may not be reached. Due to the discretely sampled 25 m calculation grids of the modelled sound fields, distances to these levels could not be estimated for practicable computational purposes. It is likely that SPL isopleths could be reached at distances between 1 m and the modelled horizontal resolution (25 m); however, distances to injurious accumulated SEL thresholds may not be reached at any range greater than 1 m due the species specific frequency weighing functions. In addition, this is in relation to representing the vessel (MODU or OSV) using a representative source level, which is based on a sound level measured in the far-field and scaled back to a standard reference distance of 1 metre from the acoustic centre of the source The indication is that these close-to-source radii are comparable to the dimensions of the modelled vessel, and therefore are levels which may only be reached within close proximity to a vessel, if at all.

Glossary

1/3-octave
One third of an octave. Note: A one-third octave is approximately equal to one decidecade (1/3 oct ≈ 1.003 ddec; ISO 2017).

1/3-octave-band
Frequency band whose bandwidth is one one-third octave. Note: The bandwidth of a one-third octave-band increases with increasing centre frequency.

absorption
The reduction of acoustic pressure amplitude due to acoustic particle motion energy converting to heat in the propagation medium.

acoustic impedance
The ratio of the sound pressure in a medium to the rate of alternating flow of the medium through a specified surface due to the sound wave.

ambient noise
All-encompassing sound at a given place, usually a composite of sound from many sources near and far (ANSI S1.1-1994 R2004), e.g., shipping vessels, seismic activity, precipitation, sea ice movement, wave action, and biological activity.

attenuation
The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium.

Auditory frequency weighting (auditory weighting function, frequency-weighting function)
The process of band-pass filtering sounds to reduce the importance of inaudible or less-audible frequencies for individual species or groups of species of aquatic mammals (ISO 2017). One example is M-weighting introduced by Southall et al. (2007) to describe "Generalized frequency weightings for various functional hearing groups of marine mammals, allowing for their functional bandwidths and appropriate in characterizing auditory effects of strong sounds".

azimuth
A horizontal angle relative to a reference direction, which is often magnetic north or the direction of travel. In navigation it is also called bearing.

bandwidth
The range of frequencies over which a sound occurs. Broadband refers to a source that produces sound over a broad range of frequencies (e.g., seismic airguns, vessels) whereas narrowband sources produce sounds over a narrow frequency range (e.g., sonar) (ANSI/ASA S1.13-2005 R2010).

bar
Unit of pressure equal to 100 kPa, which is approximately equal to the atmospheric pressure on Earth at sea level. 1 bar is equal to 10^5 Pa or 10^{11} µPa.

broadband sound level
The total sound pressure level measured over a specified frequency range. If the frequency range is unspecified, it refers to the entire measured frequency range.

broadside direction
Perpendicular to the travel direction of a source. Compare with endfire direction.

cavitation
A rapid formation and collapse of vapor cavities (i.e., bubbles or voids) in water, most often caused by a rapid change in pressure. Fast-spinning vessel propellers typically cause cavitation, which creates a lot of noise.

cetacean
Any animal in the order Cetacea. These are aquatic, mostly marine mammals and include whales, dolphins, and porpoises.

compressional wave
A mechanical vibration wave in which the direction of particle motion is parallel to the direction of propagation. Also called primary wave or P-wave.

continuous sound
A sound whose sound pressure level remains above ambient sound during the observation period (ANSI/ASA S1.13-2005 R2010). A sound that gradually varies in intensity with time, for example, sound from a marine vessel.

decade
Logarithmic frequency interval whose upper bound is ten times larger than its lower bound (ISO 2006).

decidecade
One tenth of a decade (ISO 2017). Note: An alternative name for decidecade (symbol ddec) is "one-tenth decade". A decidecade is approximately equal to one third of an octave (1 ddec ≈ 0.3322 oct) and for this reason is sometimes referred to as a "one-third octave".

decidecade band
Frequency band whose bandwidth is one decidecade. Note: The bandwidth of a decidecade band increases with increasing centre frequency.

decibel (dB)
One-tenth of a bel. Unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power (ANSI S1.1-1994 R2004).

endfire direction
Parallel to the travel direction of a source. See also broadside direction.

ensonified
Exposed to sound.

far-field
The zone where, to an observer, sound originating from an array of sources (or a spatially distributed source) appears to radiate from a single point. The distance to the acoustic far-field increases with frequency.

fast-average sound pressure level
The time-averaged sound pressure levels calculated over the duration of a pulse (e.g., 90%-energy time window), using the leaky time integrator from Plomp and Bouman (1959) and a time constant of 125 ms. Typically used only for pulsed sounds.

fast Fourier transform (FFT)
A computationally efficiently algorithm for computing the discrete Fourier transform.

frequency
The rate of oscillation of a periodic function measured in cycles-per-unit-time. The reciprocal of the period. Unit: hertz (Hz). Symbol: *f*. 1 Hz is equal to 1 cycle per second.

hearing group
Groups of marine mammal species with similar hearing ranges. Commonly defined functional hearing groups include low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air.

geoacoustic
Relating to the acoustic properties of the seabed.

hearing threshold
The sound pressure level for any frequency of the hearing group that is barely audible for a given individual in the absence of significant background noise during a specific percentage of experimental trials.

hertz (Hz)
A unit of frequency defined as one cycle per second.

high-frequency (HF) cetacean
The functional cetacean hearing group that represents those odontocetes (toothed whales) specialized for hearing high frequencies.

intermittent sound
A level of sound that abruptly drops to the background noise level several times during the observation period.

impulsive sound
Sound that is typically brief and intermittent with rapid (within a few seconds) rise time and decay back to ambient levels (NOAA 2013, ANSI S12.7-1986 R2006). For example, seismic airguns and impact pile driving.

low-frequency (LF) cetacean
The functional cetacean hearing group that represents mysticetes (baleen whales) specialized for hearing low frequencies.

masking
Obscuring of sounds of interest by sounds at similar frequencies.

median
The 50th percentile of a statistical distribution.

mid-frequency (MF) cetacean
The functional cetacean hearing group that represents those odontocetes (toothed whales) specialized for mid-frequency hearing.

Monte Carlo simulation
The method of investigating the distribution of a non-linear multi-variate function by random sampling of all of its input variable distributions.

mysticete
Mysticeti, a suborder of cetaceans, use their baleen plates, rather than teeth, to filter food from water. They are not known to echolocate, but they use sound for communication. Members of this group include rorquals (Balaenopteridae), right whales (Balaenidae), and grey whales (*Eschrichtius robustus*).

non-impulsive sound
Sound that is broadband, narrowband or tonal, brief or prolonged, continuous or intermittent, and typically does not have a high peak pressure with rapid rise time (typically only small fluctuations in decibel level) that impulsive signals have (ANSI/ASA S3.20-1995 R2008). For example, marine vessels, aircraft, machinery, construction, and vibratory pile driving (NIOSH 1998, NOAA 2015).

octave
The interval between a sound and another sound with double or half the frequency. For example, one octave above 200 Hz is 400 Hz, and one octave below 200 Hz is 100 Hz.

odontocete
The presence of teeth, rather than baleen, characterizes these whales. Members of the Odontoceti are a suborder of cetaceans, a group comprised of whales, dolphins, and porpoises. The skulls of toothed whales are mostly asymmetric, an adaptation for their echolocation. This group includes sperm whales, killer whales, belugas, narwhals, dolphins, and porpoises.

otariid
A common term used to describe members of the Otariidae, eared seals, commonly called sea lions and fur seals. Otariids are adapted to a semi-aquatic life; they use their large fore flippers for propulsion. Their ears distinguish them from phocids. Otariids are one of the three main groups in the superfamily Pinnipedia; the other two groups are phocids and walrus.

parabolic equation method
A computationally efficient solution to the acoustic wave equation that is used to model transmission loss. The parabolic equation approximation omits effects of back-scattered sound, simplifying the computation of transmission loss. The effect of back-scattered sound is negligible for most ocean-acoustic propagation problems.

particle velocity
The physical speed of a particle in a material moving back and forth in the direction of the pressure wave. Unit: metre per second (m/s). Symbol: v.

peak pressure level (PK)
The maximum instantaneous sound pressure level, in a stated frequency band, within a stated period. Also called zero-to-peak pressure level. Unit: decibel (dB).

peak-to-peak pressure level (PK-PK)
The difference between the maximum and minimum instantaneous pressure levels. Unit: decibel (dB).

percentile level, exceedance
The sound level exceeded n% of the time during a measurement.

permanent threshold shift (PTS)
A permanent loss of hearing sensitivity caused by excessive noise exposure. PTS is considered auditory injury.

phocid
A common term used to describe all members of the family Phocidae. These true/earless seals are more adapted to in-water life than are otariids, which have more terrestrial adaptations. Phocids use their hind flippers to propel themselves. Phocids are one of the three main groups in the superfamily Pinnipedia; the other two groups are otariids and walrus.

phocid pinnipeds in water (PPW)
The functional pinniped hearing group that represents true/earless seals under water.

pinniped
A common term used to describe all three groups that form the superfamily Pinnipedia: phocids (true seals or earless seals), otariids (eared seals or fur seals and sea lions), and walrus.

point source
A source that radiates sound as if from a single point (ANSI S1.1-1994 R2004).

pressure, acoustic
The deviation from the ambient hydrostatic pressure caused by a sound wave. Also called overpressure. Unit: pascal (Pa). Symbol: p.

pressure, hydrostatic
The pressure at any given depth in a static liquid that is the result of the weight of the liquid acting on a unit area at that depth, plus any pressure acting on the surface of the liquid. Unit: pascal (Pa).

received level (RL)
The sound level measured (or that would be measured) at a defined location.

rms
root-mean-square.

signature
Pressure signal generated by a source.

sound
A time-varying pressure disturbance generated by mechanical vibration waves travelling through a fluid medium such as air or water.

sound exposure
Time integral of squared, instantaneous frequency-weighted sound pressure over a stated time interval or event. Unit: pascal-squared second ($Pa^2·s$) (ANSI S1.1-1994 R2004).

sound exposure level (SEL)
A cumulative measure related to the sound energy in one or more pulses. Unit: dB re 1 $\mu Pa^2·s$. SEL is expressed over the summation period (e.g., per-pulse SEL [for airguns], single-strike SEL [for pile drivers], 24-hour SEL).

sound exposure spectral density
Distribution as a function of frequency of the time-integrated squared sound pressure per unit bandwidth of a sound having a continuous spectrum (ANSI S1.1-1994 R2004). Unit: $\mu Pa^2·s/Hz$.

sound field
Region containing sound waves (ANSI S1.1-1994 R2004).

sound intensity
Sound energy flowing through a unit area perpendicular to the direction of propagation per unit time.

sound pressure level (SPL)
The decibel ratio of the time-mean-square sound pressure, in a stated frequency band, to the square of the reference sound pressure (ANSI S1.1-1994 R2004).

For sound in water, the reference sound pressure is one micropascal (p_0 = 1 µPa) and the unit for SPL is dB re 1 μPa^2:

$$L_p = 10\log_{10}(p^2/p_0^2) = 20\log_{10}(p/p_0)$$

Unless otherwise stated, SPL refers to the root-mean-square (rms) pressure level. See also 90% sound pressure level and fast-average sound pressure level. Non-rectangular time window functions may be applied during calculation of the rms value, in which case the SPL unit should identify the window type.

sound speed profile
The speed of sound in the water column as a function of depth below the water surface.

source level (SL)
The sound level measured in the far-field and scaled back to a standard reference distance of 1 metre from the acoustic centre of the source. Unit: dB re 1 µPa·m (pressure level) or dB re 1 $\mu Pa^2·s·m$ (exposure level).

spectrogram
A visual representation of acoustic amplitude compared with time and frequency.

spectrum
An acoustic signal represented in terms of its power, energy, mean-square sound pressure, or sound exposure distribution with frequency.

temporary threshold shift (TTS)
Temporary loss of hearing sensitivity caused by excessive noise exposure.

transmission loss (TL)
The decibel reduction in sound level between two stated points that results from sound spreading away from an acoustic source subject to the influence of the surrounding environment. Also referred to as propagation loss.

wavelength
Distance over which a wave completes one cycle of oscillation. Unit: metre (m). Symbol: λ.

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Appendix A. Acoustic Metrics

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 µPa. Because the perceived loudness of sound, especially impulsive noise such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate noise and its effects on marine life. We provide specific definitions of relevant metrics used in the accompanying report. Where possible we follow the ANSI and ISO standard definitions and symbols for sound metrics, but these standards are not always consistent.

The zero-to-peak sound pressure level (PK; L_{pk}; $L_{p,pk}$; dB re 1 µPa), is the maximum instantaneous sound pressure level in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{p,pk} = 20\log_{10}\left[\frac{\max(|p(t)|)}{p_0}\right] \quad \text{(A-1)}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of a noise event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure level (PK-PK; $L_{pk\text{-}pk}$; $L_{p,pk\text{-}pk}$; dB re 1 µPa) is the difference between the maximum and minimum instantaneous sound pressure levels in a stated frequency band attained by an impulsive sound, $p(t)$:

$$L_{p,pk-pk} = 10\log_{10}\left\{\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2}\right\} \quad \text{(A-2)}$$

The sound pressure level (SPL; L_p; dB re 1 µPa) is the rms pressure level in a stated frequency band over a specified time window (T, s) containing the acoustic event of interest. It is important to note that SPL always refers to a rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T p^2(t)dt \Big/ p_0^2\right) \quad \text{(A-3)}$$

The SPL represents a nominal effective continuous sound over the duration of an acoustic event, such as the emission of one acoustic pulse, a marine mammal vocalization, the passage of a vessel, or over a fixed duration. Because the window length, T, is the divisor, events with similar sound exposure level (SEL) but more spread out in time have a lower SPL. A fixed window length of 0.125 s (critical duration defined by Tougaard et al. (2015)) is used in this study for impulsive sounds.

The sound exposure level (SEL; L_E; $L_{E,p}$; dB re 1 µPa²·s) is a measure related to the acoustic energy contained in one or more acoustic events (N). The SEL for a single event is computed from the time-integral of the squared pressure over the full event duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)dt \Big/ T_0 p_0^2\right) \quad \text{(A-4)}$$

where T_0 is a reference time interval of 1 s. The SEL continues to increase with time when non-zero pressure signals are present. It therefore can be construed as a dose-type measurement, so the integration time used must be carefully considered in terms of relevance for impact to the exposed recipients.

SEL can be calculated over periods with multiple acoustic events or over a fixed duration. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, SEL can be computed by summing (in linear units) SEL of the *N* individual events:

$$L_{E,N} = 10\log_{10}\left(\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}}\right) . \tag{A-5}$$

If applied, the frequency weighting of an acoustic event should be specified, as in the case of weighted SEL (e.g., $L_{E,LFC,24h}$; Appendix A.3). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should else be specified.

A.2. Marine Mammal Impact Criteria

It has been long recognised that marine mammals can be adversely affected by underwater anthropogenic noise. For example, Payne and Webb (1971) suggested that communication distances of fin whales are reduced by shipping sounds. Subsequently, similar concerns arose regarding effects of other underwater noise sources and the possibility that impulsive sources—primarily airguns used in seismic surveys—could cause auditory injury. This led to a series of workshops held in the late 1990s, conducted to address acoustic mitigation requirements for seismic surveys and other underwater noise sources (NMFS 1998, ONR 1998, Nedwell and Turnpenny 1998, HESS 1999, Ellison and Stein 1999). In the years since these early workshops, a variety of thresholds have been proposed for both injury and disturbance. The following sections summarise the recent development of thresholds; however, this field remains an active research topic.

A.2.1. Injury

In recognition of shortcomings of the SPL-only based injury criteria, in 2005 NMFS sponsored the Noise Criteria Group to review literature on marine mammal hearing to propose new noise exposure criteria. Some members of this expert group published a landmark paper (Southall et al. 2007) that suggested assessment methods similar to those applied for humans. The resulting recommendations introduced dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted 24h refers to the accumulation period for calculating SEL. The peak pressure level criterion is not frequency weighted whereas SEL_{24h} is frequency weighted according to one of four marine mammal species hearing groups: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively) and Pinnipeds in Water (PINN). These weighting functions are referred to as M-weighting filters (analogous to the A-weighting filter for human; Appendix A.3). The SEL_{24h} thresholds were obtained by extrapolating measurements of onset levels of Temporary Threshold Shift (TTS) in belugas by the amount of TTS required to produce Permanent Threshold Shift (PTS) in chinchillas. The Southall et al. (2007) recommendations do not specify an exchange rate, which suggests that the thresholds are the same regardless of the duration of exposure (i.e., it implies a 3 dB exchange rate).

Wood et al. (2012) refined Southall et al.'s (2007) thresholds, suggesting lower injury values for LF and HF cetaceans while retaining the filter shapes. Their revised thresholds were based on TTS-onset levels in harbour porpoises from Lucke et al. (2009), which led to a revised impulsive sound PTS threshold for HF cetaceans of 179 dB re 1 $\mu Pa^2 \cdot s$. Because there were no data available for baleen whales, Wood et al. (2012) based their recommendations for LF cetaceans on results obtained from MF cetacean studies. In particular they referenced Finneran and Schlundt (2010) research, which found mid-frequency cetaceans are more sensitive to non-impulsive sound exposure than Southall et al. (2007) assumed. Wood et al. (2012) thus recommended a more conservative TTS-onset level for LF cetaceans of 192 dB re 1 $\mu Pa^2 \cdot s$.

As of 2017, an optimal approach is not apparent. There is consensus in the research community that an SEL-based method is preferable either separately or in addition to an SPL-based approach to assess the potential for injuries. In August 2016, after substantial public and expert input into three draft versions and based largely on the above-mentioned literature (NOAA 2013, 2015, 2016), NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes injury criteria with new thresholds and frequency weighting functions for the five hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018 (NMFS 2018). Southall et al. (2019) revisited the interim criteria published in 2007; all noise exposure criteria in NMFS (2018) and Southall et al. (2019) are identical (for impulsive and non-impulsive sounds), however the mid-frequency cetaceans from NMFS (2018) are classified as high-frequency cetaceans in Southall et al. (2019), and high-frequency cetaceans from NMFS (2018) are classified as very-high-frequency cetaceans in Southall et al. (2019).

A.2.2. Behavioural response

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. However, it is recognised that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison and Frankel 2012, Southall et al. 2016).

NMFS currently uses step function (all-or-none) thresholds of 120 dB re 1 µPa SPL (unweighted) for non-impulsive sounds to assess and regulate noise-induced behavioural impacts for marine mammals (NOAA 2019). The 120 dB re 1 µPa threshold is associated with continuous sources and was derived based on studies examining behavioural responses to drilling and dredging (NOAA 2018), referring to Malme et al. (1983), Malme et al. (1984), and Malme et al. (1986), which were considered in Southall et al. (2007). Malme et al. (1986) found that playback of drillship noise did not produce clear evidence of disturbance or avoidance for levels below 110 dB re 1 µPa (SPL), possible avoidance occurred for exposure levels approaching 119 dB re 1 µPa. Malme et al. (1984) determined that measurable reactions usually consisted of rather subtle short-term changes in speed and/or heading of the whale(s) under observation. It has been shown that both received level and proximity of the sound source is a contributing factor in eliciting behavioural reactions in humpback whales (Dunlop et al. 2017, Dunlop et al. 2018).

A.3. Marine Mammal Frequency Weighting

The potential for noise to affect animals depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

A.3.1. Marine mammal frequency weighting functions

In 2015, a U.S. Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. The new frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] \qquad \text{(A-6)}$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid-, and high-frequency cetaceans, phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses noise impacts on marine mammals (NMFS 2016, NMFS 2018). Table A-1 lists the frequency-weighting parameters for each hearing group; Figure A-1 shows the resulting frequency-weighting curves.

Table A-1. Parameters for the auditory weighting functions used in this project as recommended by NMFS (2018).

Hearing group	**a**	**b**	***f_{lo}* (Hz)**	***f_{hi}* (kHz)**	***K* (dB)**
Low-frequency cetaceans (baleen whales)	1.0	2	200	19,000	0.13
Mid-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)	1.6	2	8,800	110,000	1.20
High-frequency cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	1.8	2	12,000	140,000	1.36
Phocid seals in water	1.0	2	1,900	30,000	0.75
Otariid seals in water	2.0	2	940	25,000	0.64

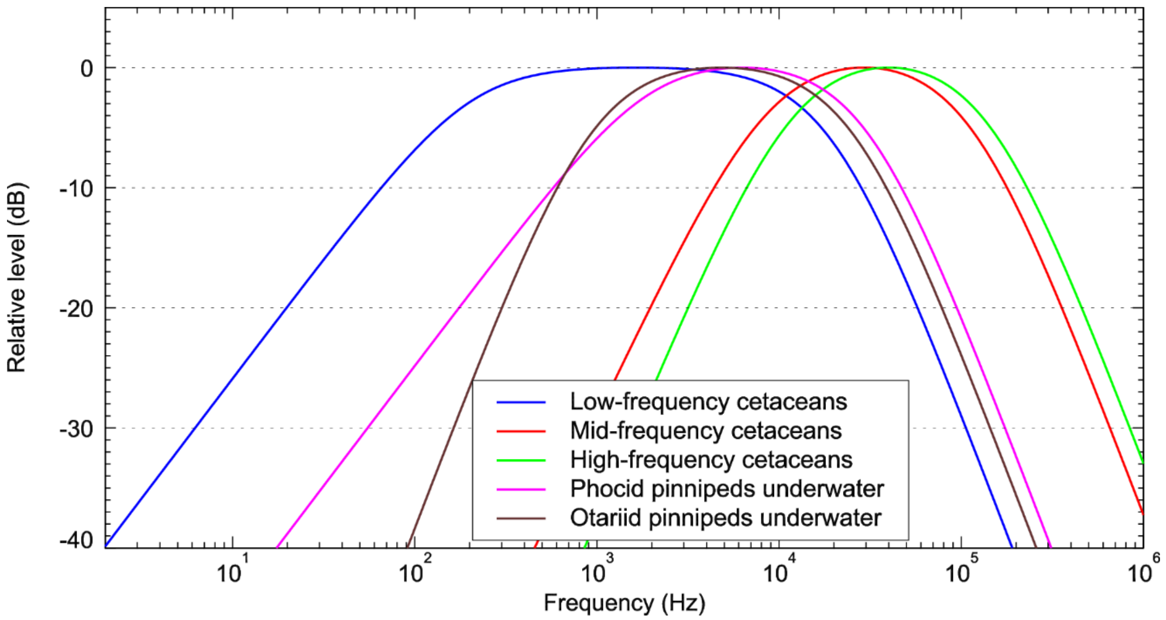

Figure A-1. Auditory weighting functions for functional marine mammal hearing groups as recommended by NMFS (2018).

Appendix B. Thruster Source Level Estimation

Underwater sound that radiates from vessels is produced mainly by propeller and thruster cavitation, with a smaller fraction of sound produced by sound transmitted through the hull, such as by engines, gearing, and other mechanical systems. Sound levels tend to be the highest when thrusters are used to position the vessel and when the vessel is transiting at high speeds. A vessel's sound signature depends on the vessel's size, power output, propulsion system, and the design characteristics of the given system (e.g., blade shape and size). A vessel produces broadband acoustic energy with most of the energy emitted below a few kilohertz. Sound from onboard machinery, particularly sound below 200 Hz, dominates the sound spectrum before cavitation begins—normally around 8–12 knots on many commercial vessels (Spence et al. 2007). Under higher speeds and higher propulsion system load, the acoustic output from the cavitation processes on the propeller blades dominates other sources of sound on the vessel such as machinery or hull vibration (Leggat et al. 1981).

A vessel equipped with propellers/thrusters has two primary sources of sound that propagate from the unit: the machinery and the propellers. For thrusters operating in the heavily loaded conditions, the acoustic energy generated by the cavitation processes on the propeller blades dominates (Leggat et al. 1981). The sound power from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed.

Based on an analysis of acoustic data, Ross (1976) provided the following formula for the sound levels from a vessel's propeller, operating in calm, open ocean conditions:

$$L_{100} = 155 + 60\log(u/25) + 10\log(B/4)\,, \tag{B-1}$$

where L_{100} is the spectrum level at 100 Hz, u is the propeller tip speed (m/s), and B is the number of propeller blades. Equation B-1 gives the total energy produced by the propeller cavitation at frequencies between 100 Hz and 10 kHz. This equation is valid for a propeller tip speed between 15 and 50 m/s. The spectrum is assumed to be flat below 100 Hz. Its level is assumed to fall off at a rate of −6 dB per octave above 100 Hz (Figure B-1).

Another method of predicting the source level of a propeller was suggested by Brown (1977). For propellers operating in heavily loaded conditions, the formula for the sound spectrum level is:

$$\mathrm{SL}_B = 163 + 40\log D + 30\log N + 10\log B + 20\log f + 10\log(A_c/A_D)\,, \tag{B-2}$$

where D is the propeller diameter (m), N is the propeller revolution rate per second, B is the number of blades, A_C is the area of the blades covered by cavitation, and A_D is the total propeller disc area. Similar to Ross's approach, the spectrum below 100 Hz is assumed to be flat. The tests with a naval propeller operating at off-design heavily loaded conditions showed that Equation B-2 should be used with a value of $(A_c/A_D) = 1$ (Leggat et al. 1981).

The combined source level for multiple thrusters operating together can be estimated using the formula:

$$\mathrm{SL}_{\mathrm{total}} = 10\log_{10}\sum_i 10^{\frac{SL_i}{10}}, \tag{B-3}$$

where $\mathrm{SL}_{1,\ldots,N}$ are the source levels of individual thrusters. If the vessel is equipped with the same type of thrusters, the combined source level can be estimated using the formula:

$$\mathrm{SL}_N = \mathrm{SL} + 10\log N \tag{B-4}$$

where N is the total number of thrusters of the same type.

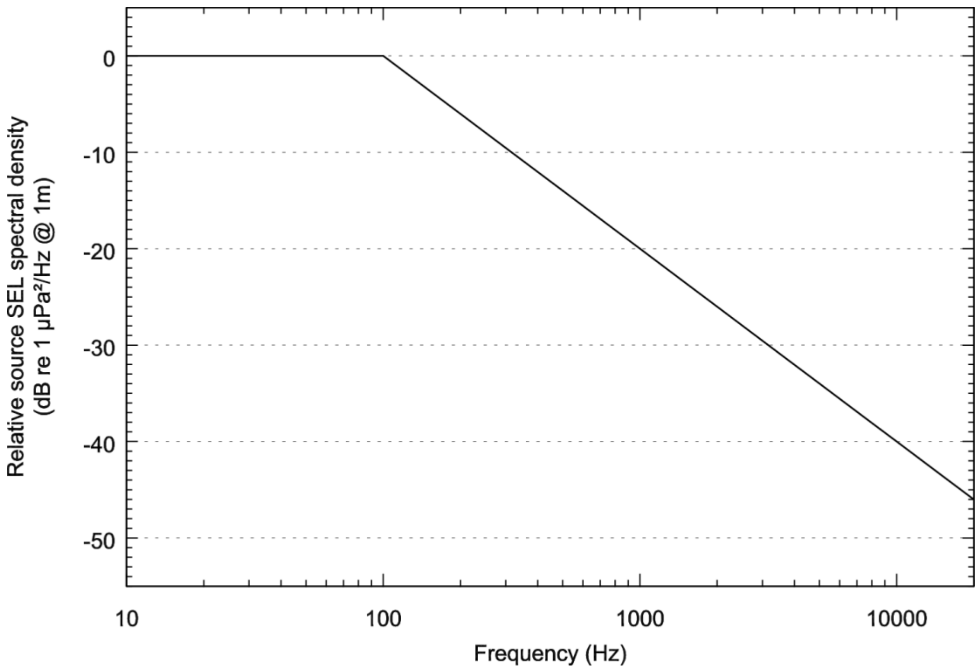

Figure B-1. Estimated sound spectrum from cavitating propeller (Leggat et al. 1981).

Appendix C. Sound Propagation Models

C.1. Transmission Loss

The propagation of sound through the environment was modelled by predicting the acoustic transmission loss—a measure, in decibels, of the decrease in sound level between a source and a receiver some distance away. Geometric spreading of acoustic waves is the predominant way by which transmission loss occurs. Transmission loss also happens when the sound is absorbed and scattered by the seawater, and absorbed scattered, and reflected at the water surface and within the seabed. Transmission loss depends on the acoustic properties of the ocean and seabed; its value changes with frequency.

If the acoustic source level (SL), expressed in dB re 1 µPa^{2}m^2, and transmission loss (TL), in units of dB, at a given frequency are known, then the received level (RL) at a receiver location can be calculated in dB re 1 µPa by:

$$\mathrm{RL} = \mathrm{SL} - \mathrm{TL} \tag{C-1}$$

C.2. MONM-BELLHOP

Long-range sound fields were computed using JASCO's Marine Operations Noise Model (MONM). While other models may be more accurate for steep-angle propagation in high-shear environment, MONM is well suited for effective longer-range estimation. This model computes sound propagation at frequencies of 10 Hz to 1.6 kHz via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). MONM's approximation breaks down for seafloor shear speeds greater than approximately 600 m/s and higher shear wave speeds usually found in cemented and semi-cemented carbonate rock. A similar profile was used in a similar study for Origin in the Otway Basin (McPherson et al. 2016) the results of which support the use of MONM for this model environment. MONM computes sound propagation at frequencies > 1.6 kHz via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed, which results from partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

This version of MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is significant for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results.

MONM computes acoustic fields in three dimensions by modelling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure C-1).

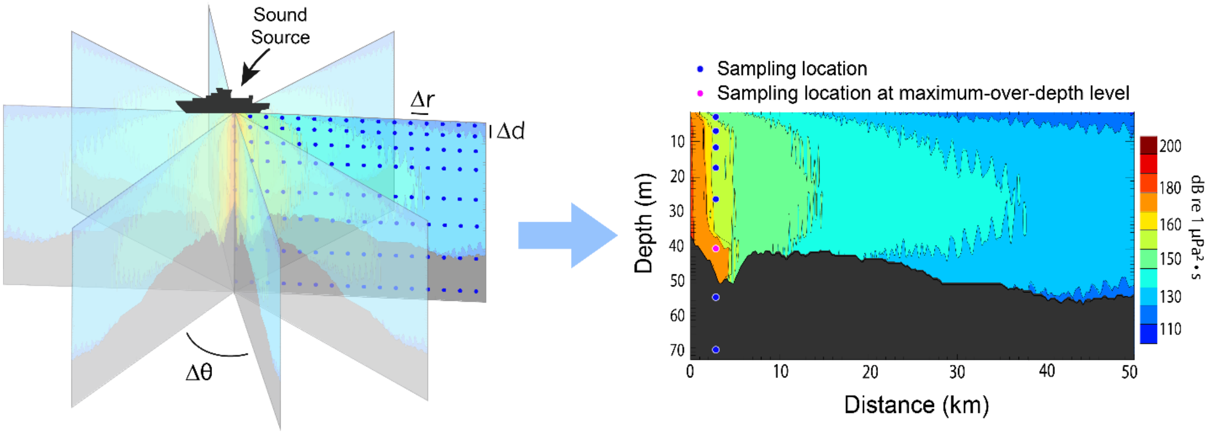

Figure C-1. The N×2-D and maximum-over-depth modelling approach used by MONM.

MONM treats frequency dependence by computing acoustic transmission loss at the centre frequencies of 1/3-octave-bands. Sufficiently many 1/3-octave-bands, starting at 10 Hz, are modelled to include most of the acoustic energy emitted by the source. At each centre frequency, the transmission loss is modelled within each of the N vertical planes as a function of depth and range from the source. The 1/3-octave-band received per-pulse SEL are computed by subtracting the band transmission loss values from the directional source level in that frequency band. Composite broadband received per-pulse SEL are then computed by summing the received 1/3-octave-band levels.

The received per-second vessel (MODU and OSV sources) SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. For areas with deep water, sampling is not performed at depths beyond those reachable by marine mammals. The received per-pulse or per-second SEL at a surface sampling location is taken as the maximum value that occurs over all samples within the water column, i.e., the maximum-over-depth received per-pulse SEL. These maximum-over-depth per-pulse SEL are presented as colour contours around the source.

An inherent variability in measured sound levels is caused by temporal variability in the environment and the variability in the signature of repeated acoustic impulses (sample sound source verification results is presented in Figure C-2). While MONM's predictions correspond to the averaged received levels, cautionary estimates of the threshold radii are obtained by shifting the best fit line (solid line, Figure C-2) upward so that the trend line encompasses 90% of all the data (dashed line, Figure C-2).

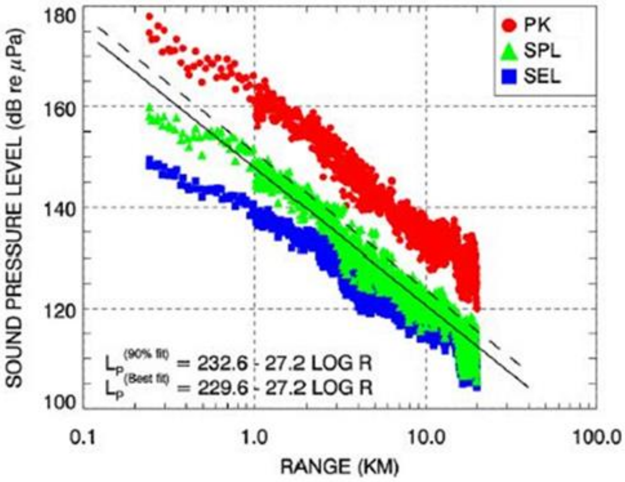

Figure C-2. PK and SPL and per-pulse SEL versus range from a 20 in^3 seismic source. Solid line is the least squares best fit to SPL. Dashed line is the best fit line increased by 3.0 dB to exceed 90% of all SPL values (90th percentile fit) (Ireland et al. 2009, Figure 10)

Appendix D. Methods and Parameters

This section describes the specifications of the seismic source that was used at all sites and the environmental parameters used in the propagation models.

D.1. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure D-1).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure D-1(a). In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure D-1(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.

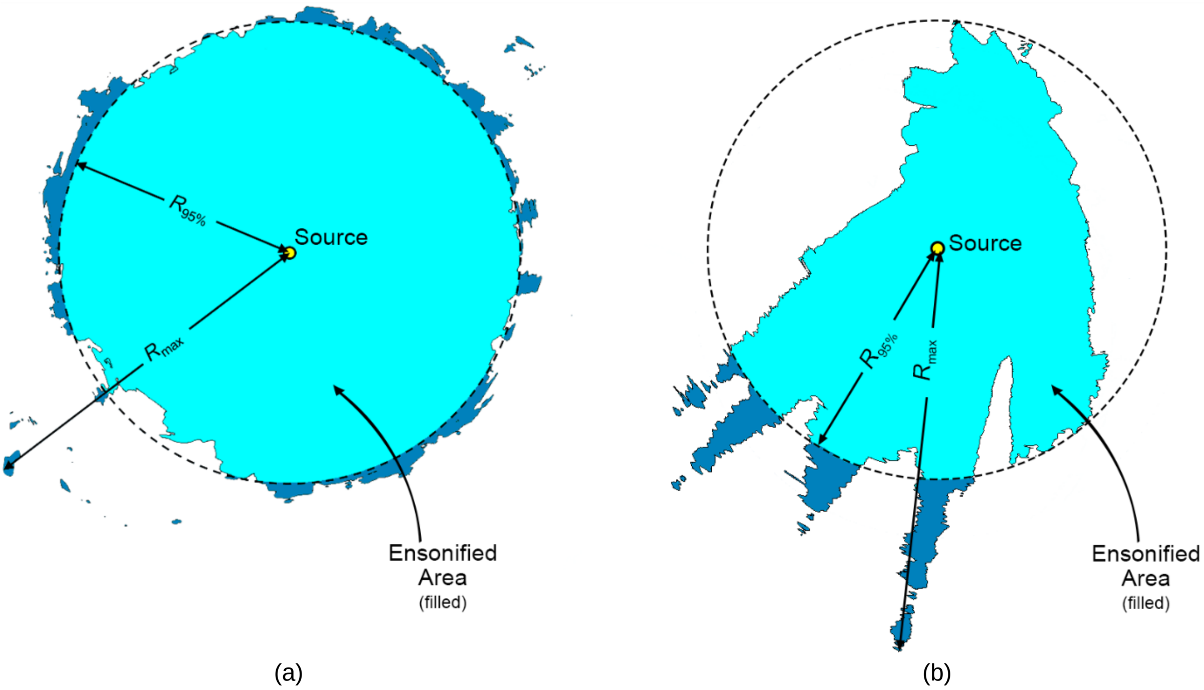

Figure D-1. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ ranges shown for two different scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

D.2. Environmental Parameters

D.2.1. Bathymetry

Water depths throughout the modelled areas were extracted from the Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009). Bathymetry data were re-gridded onto a Map Grid of Australia (MGA) coordinate projection (Zone 54) with a regular grid spacing of 100 × 100 m.

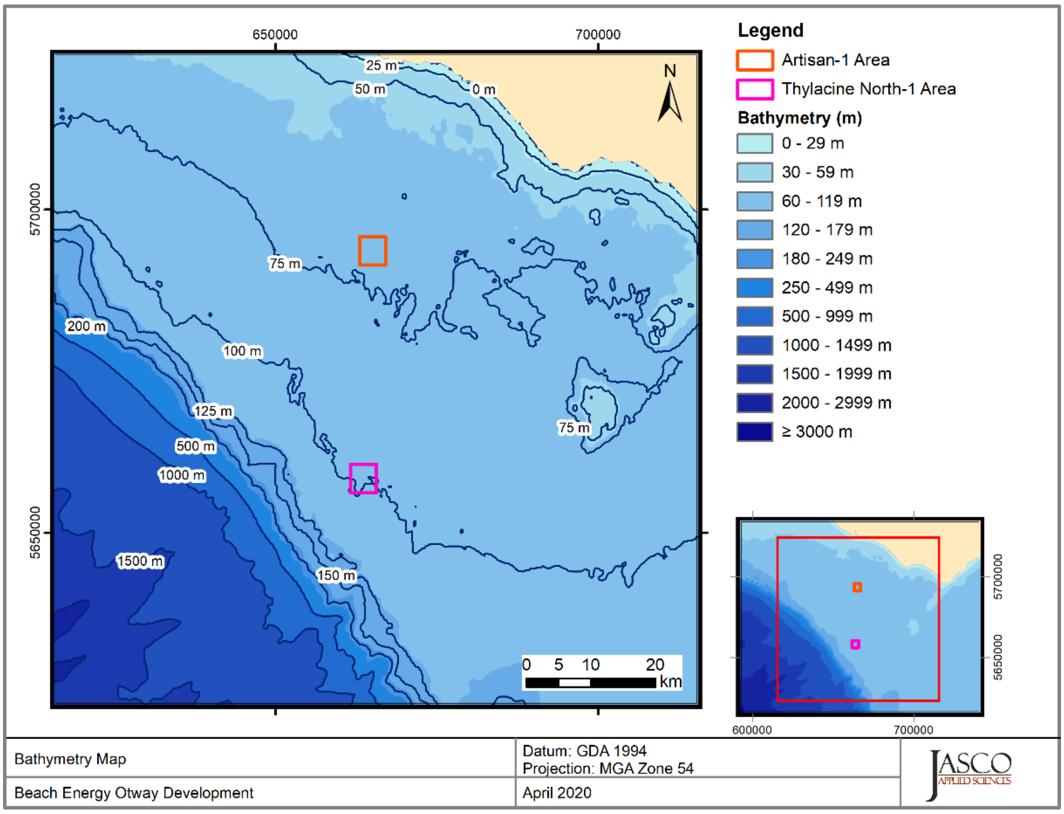

Figure D-2. Bathymetry in the modelled area.

D.2.2. Sound speed profile

The sound speed profile in the area was derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office's *Generalized Digital Environmental Model V 3.0* (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the U.S. Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles at distances less than 76 km around the modelled site. The June sound speed profile is expected to be most favourable to longer-range sound propagation across the entire year. As such, June was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. Figure D-3 shows the resulting profile, which was used as input to the sound propagation modelling.

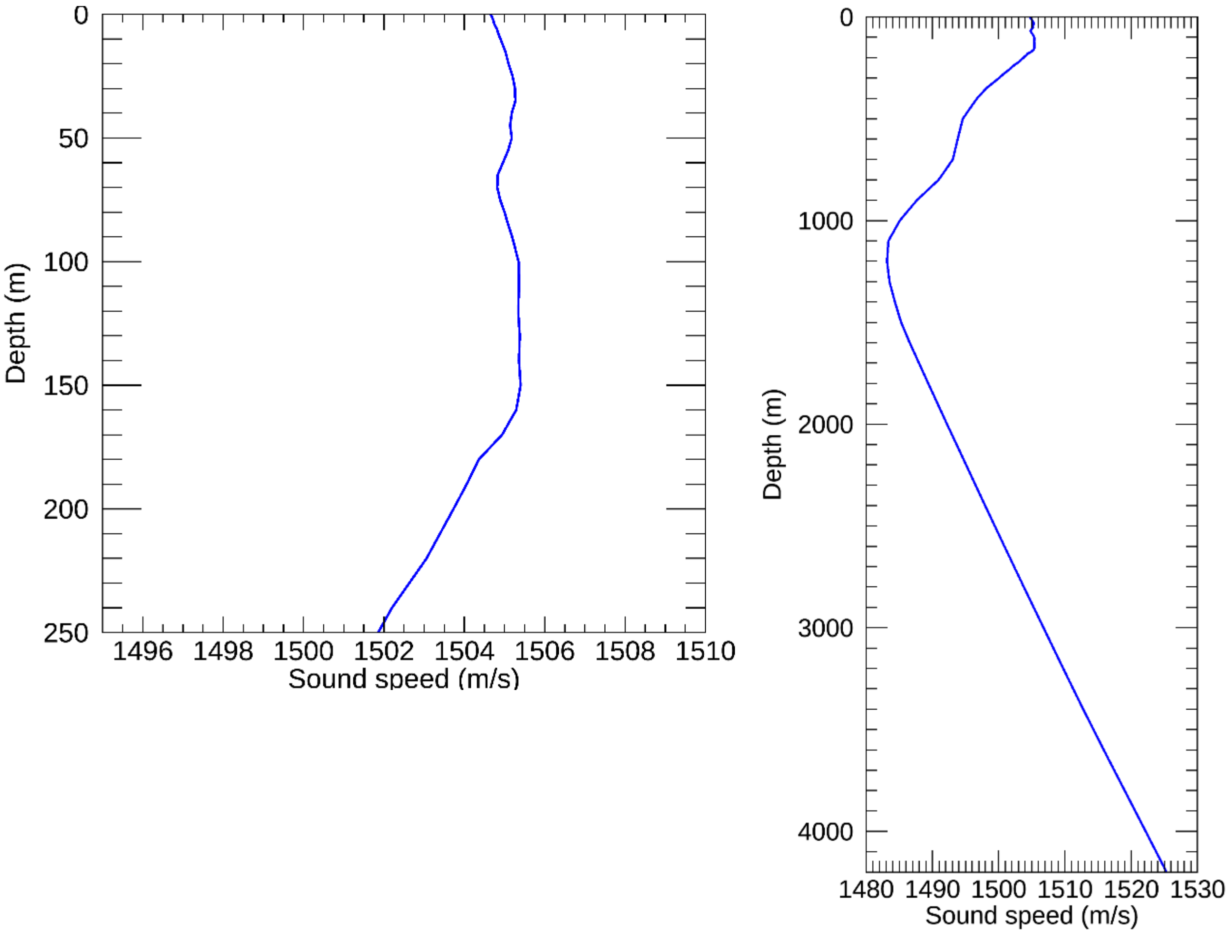

Figure D-3. The modelling sound speed profile corresponding to June: top 250 m (left) and full profile (right) Profiles are calculated from temperature and salinity profiles from *Generalized Digital Environmental Model* V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

D.2.3. Geoacoustics

The propagation model used in this study consider a single geoacoustic profile for each development area. These profiles determine how sound is reflected from the seabed, as well as how it is transmitted, reflected and absorbed into the sediment layers. As in previous acoustic studies in the area, the modelling area was divided into two seabed types (Wood and McPherson 2018). Both areas are located on the continental shelf, however the seabed in the Thylacine North-1 area is closer to the continental slope in deeper waters and was characterised by well-cemented carbonate caprock (calcarenite), overlying semi-cemented carbonate rock (calcarenite). The seabed in the Artisan-1, located in shallower waters, was characterised by a thin veneer of coarse sand/gravel overlying semi-cemented carbonate rock. This contrast in seabed environment is consistent with larger scale geological data and interpretations of the Australian continental shelf environment (James and Bone 2010). Table D-1 and Table D-2 present the geoacoustic profiles used modelled sites in each respective development area.

Table D-1. *Thylacine North-1*: Geoacoustic profile. Each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–0.5	Well-cemented carbonate caprock	2.7	2600	0.50	500	0.4
0.5–20	Increasingly cemented calcarenite	2.2	2000	0.30		
20-40		2.3	2120	0.34		
40-60		2.4	2240	0.38		
60-80		2.5	2360	0.42		
80–100		2.6	2480	0.46		
>100	Well-cemented calcarenite	2.7	2600	0.5		

Table D-2. *Artisan-1*: Geoacoustic profile. Each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–1	Coarse carbonate sand	2.03	1800	0.85	300	3.68
1–20	Increasingly cemented calcarenite	2.2	2000	0.30		
20-40		2.3	2120	0.34		
40-60		2.4	2240	0.38		
60-80		2.5	2360	0.42		
80–100		2.6	2480	0.46		
>100	Well-cemented calcarenite	2.7	2600	0.5		

D.3. Model Validation Information

Predictions from JASCO’s propagation models (MONM, FWRAM, and VSTACK) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Artic, Canadian and southern United States waters, Greenland, Russia and Australia (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities which have included internal validation of the modelling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016).