Plan

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Environment Plan

Otway Offshore Operations Summary

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

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
3	14/02/2018	Final – Reissued to DEDJTR and NOPSEMA for acceptance	SD	KHU	MSA
1	13/01/2024	Accepted EP	PWE	Xodus	PWE
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Review due	Review frequency
16/07/2029	5 year/s

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

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Acronyms

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

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

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

Terms/acronym	Definition/Expansion
NZE Scenario	Net Zero Emissions by 2050 Scenario
O_3	Ozone
OEMS	Operations Excellence Management System
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS Regulations (Vic)	Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Victorian)
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Commonwealth)
OPP	Offshore Project Proposal
Origin	Origin Energy Resources Limited
ORP	Oxidation-Reduction Potential
OSCP	Oil Spill Contingency Plan
OSMP	Operational and Scientific Monitoring Plan
OSTM	Oil Spill Trajectory Modelling
OSV	Offshore Support Vessel
OWR	Oiled Wildlife Response
Pb	Lead
PCM	Pipeline Corrosion Monitor
PFC	Perfluorocarbons
POLREP	Marine Pollution Report
POWBONS Act	Pollution of Waters by Oil and Noxious Substances Act 1986
ppm	Parts Per Million
PSZ	Petroleum Safety Zone
PTS	Permanent Threshold Shift
ROV	Remotely Operated Vehicle
SBTF	Southern Bluefin Tuna Fishery
SCCP	Source Control Contingency Plan
SCM	Subsea Control Module
SCSSV	Surface Controlled Subsurface Safety Valve
SDU	Subsea Distribution Unit
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMR	South-East Marine Region
SESSF	Southern and Eastern Scalefish And Shark Fishery
SETFIA	South East Trawl Fishing Industry Association

Terms/acronym	Definition/Expansion
SF6	Sulphur hexafluoride
SHX	Subsea Heat Exchanger
SIMAP	Spill Impact Mapping Analysis Program
SIV	Seafood Industry Victoria
SMC	Subsea Manifold Cooler
SMPEP	Shipboard Marine Pollution Emergency Plan
SMS	Short Message Service
SO_2	Sulphur dioxide
SPCU	Subsea Power and Control Unit
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SST	Sea surface temperature
SVS	Subsea Valve Skid
TEC	Threatened Ecological Community
TOLC	Top of Line Corrosion
TRH	Total Recoverable Hydrocarbon
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
TUTA	Topside Umbilical Termination Assembly
UTA	Umbilical Termination Assembly
VLSFO	Very Low Sulphur Fuel Oil
VWMS	Victorian Waterway Management Strategy
WBDF	Water-Based Drilling Fluid
WECS	Well Engineering and Construction Management System
WOMP	Well Operations Management Plan
Woodside	Woodside Petroleum Ltd
WRSSV	Wireline Retrievable Subsurface Safety Valve

1 Introduction

This Environment Plan (EP) Summary document has been prepared in accordance with Regulation 13E of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Commonwealth and Victoria OPGGS Regulations) as required by the Offshore Petroleum Greenhouse Gas Storage Act 2010 (Victorian OPGGS Act).

This EP Summary details the potential environmental effects of the offshore environment that may occur from the inspection, maintenance, and repair (and associated activities) of the offshore assets associated with the Otway Gas Development. The measures to mitigate or continually reduce potential impacts to the environment as low as reasonably practicable (ALARP) are also summarised in this EP Summary.

The Otway Offshore Operations EP was accepted in August 2022 and is valid until 2027 (NOPSEMA Reference 6731).

1.1 Scope of this Document

In accordance with Regulation 13E (4) of the Commonwealth OPGGS Regulations, this EP Summary includes details about the location and nature of the activity, the receiving environment, consultation undertaken, the environmental impacts, risks and associated control measures, monitoring and environmental performance measures and emergency response arrangements.

1.2 Nominated title holder and Liaison Person

Beach Energy (Operations) Limited is the Operator of the Otway Gas Development of T/L2, T/L3, T/PL3, VIC/L23, VIC/P43, VIC/PL36, VIC/PL36(V), wholly owned by Beach Energy Limited (Beach).

In accordance with the OPGGS Regulations (offshore) Victoria Regulation 13E (4)(ix) the details of the titleholder's liaison person for the activity of the EP is provided below:

The Titleholder's nominated liaison person is:

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2 Description of the Activity

The Otway Gas Development operations consist of producing natural gas including condensate from the Geographe and Thylacine fields and processed onshore at the Otway Gas Plant. The Beach Otway Offshore Operations EP is a revision to the recently accepted EP (August 2022) to address potentially new or increased environmental impacts or risks as per Regulation 17 (6) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

2.1 Location of Activity

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

The operational area includes a 500 m buffer around all subsea infrastructure and wells, including the Otway Pipeline System (Figure 1). The indicative coordinates, petroleum titles, approximate water depth and distance from Port Campbell are presented in Table 1 for the main infrastructure components of the Otway Gas Development. Section 3.4.5 details the status of the main components of infrastructure associated with the Otway offshore operations.

Table 1. Otway Gas Development Main Infrastructure Locations

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

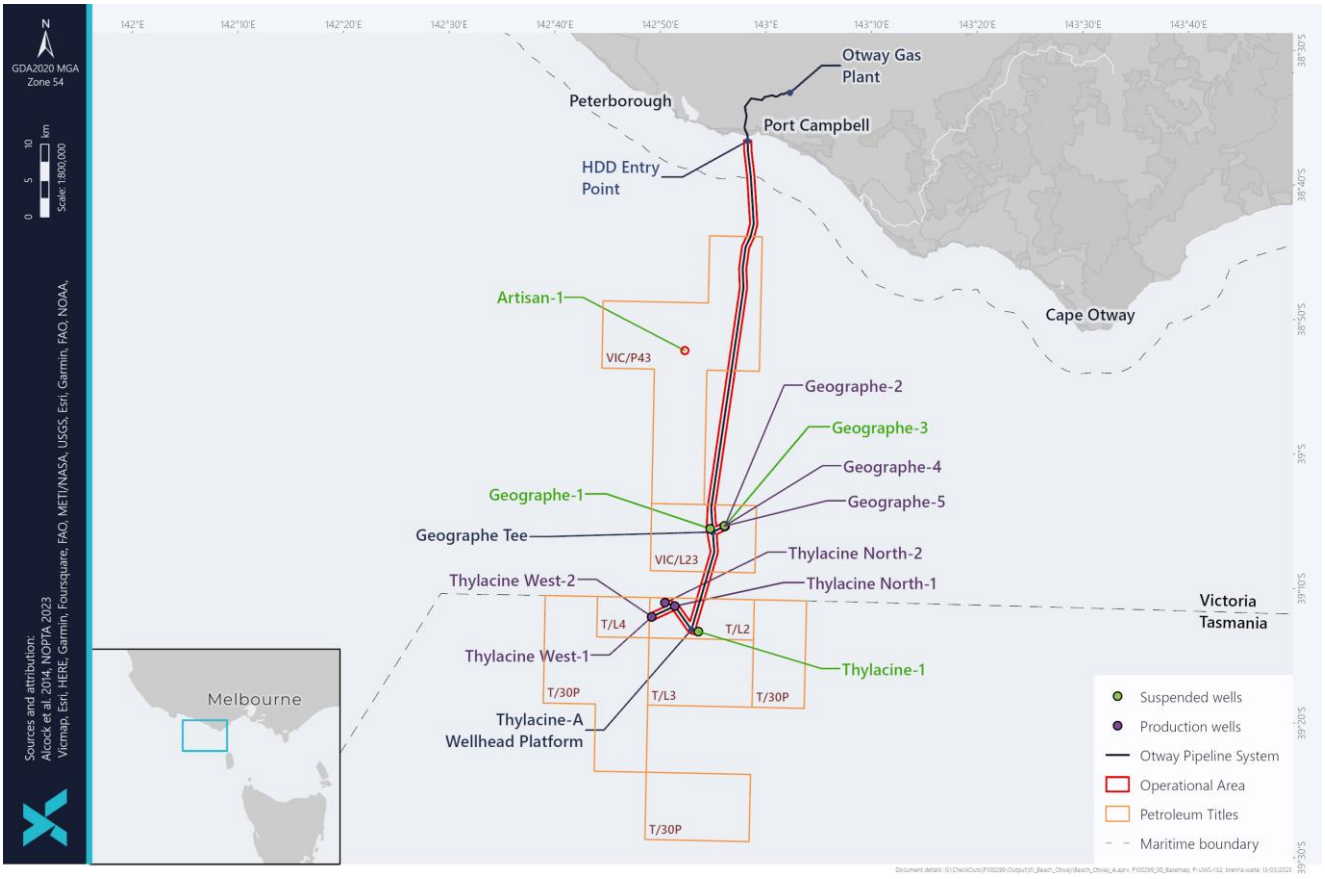

Figure 1. Otway Offshore Development Location and Operational Area

2.2 Field Characteristics

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

The condensate from the Geographe field is a light condensate with density of 0.751 g/cm3 and viscosity of approximately 0.5cP at 25oC. The condensate at Thylacine is again a light condensate with a slightly higher density of 0.805g/cm3 and a viscosity of approximately 0.88cP at 20°C. The reservoir properties for Thylacine and Geographe and condensate boiling point ranges are provided in Section 3 of the EP.

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

The condensate ratio ranges from 10 to 20 barrels per 1 million standard cubic feet (MMSCF) of gas, dependent on the field, well and retrograde effects. Hydrogen sulphide (H2S) exists in small quantities and the production system is designed for a concentration of 20 ppmv as a contingency in the event of an increase in H2S levels. Combined Thylacine/Geographe raw gas at the plant inlet is tested quarterly for H2S, test in January 2023 was 6 ppmv.

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

The design allowance for mercury is 25 µg/m3 in the gas and 40 ppb in the condensate. Traces of mercury have been detected in the condensate stream from the Thylacine and Geographe fields. Combined Thylacine/Geographe raw gas at the plant inlet is tested quarterly for mercury, test results in February 2023 were 7 µg/m3. Combined Thylacine/Geographe condensate at the inlet of the Mercury Removal Unit is tested quarterly for mercury, test results in February 2023 were 8 ppb.

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

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

2.3 Facilities and Infrastructure Description

An overview of the facilities and infrastructure associated with the recovery of natural gas from the Thylacine and Geographe fields are described in this section and detailed in Section 3.4 of the EP. This section and Figure 2 provides an overview of the Thylacine and Geographe operations infrastructure described in section 3.4 of the EP.

2.3.1 Thylacine-A Wellhead Platform

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

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

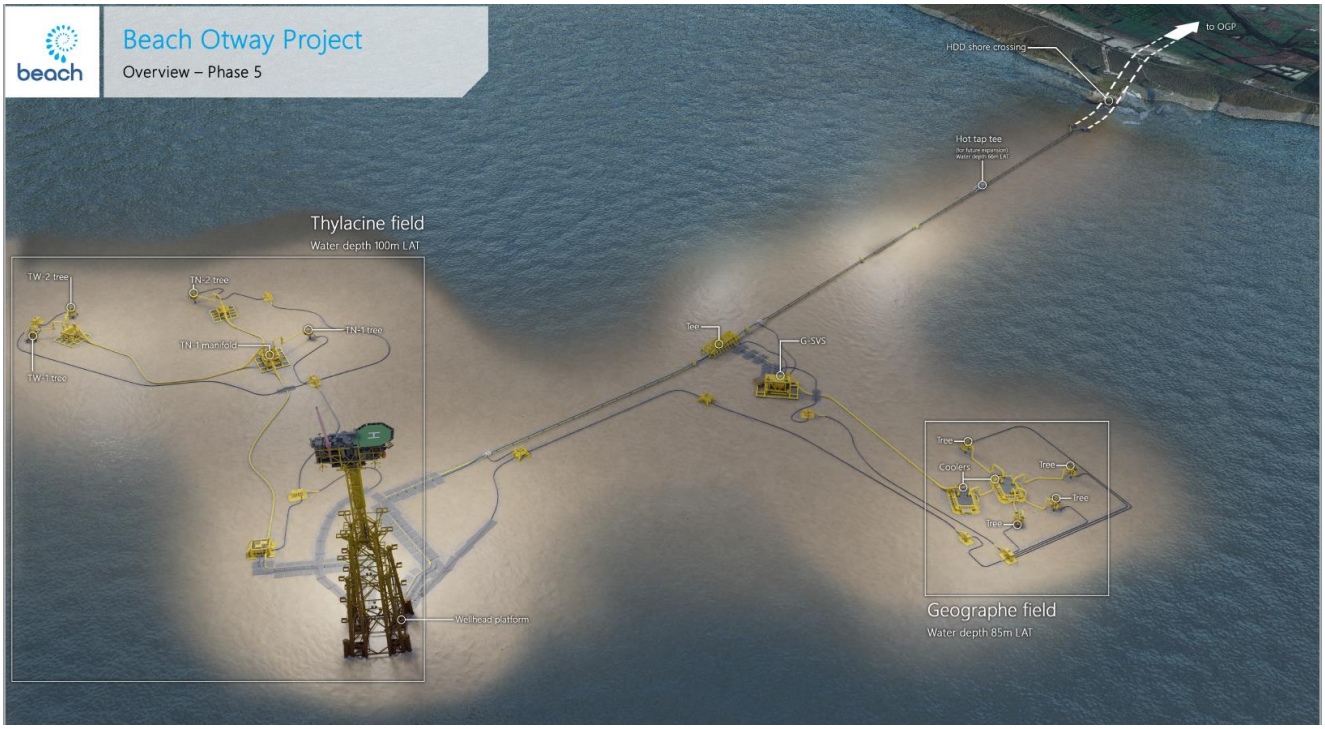

Figure 2. Beach Otway Development Infrastructure

Table 2. Thylacine-A Wellhead Platform Utilities

Utility	Description
Power Generation	Platform power is generated from two gas engines; one normally operating and one standby. A diesel generator (and associated diesel storage) can be installed on the platform to provide emergency power in the event the gas engines are not operational or to provide additional power in the event of a major campaigns (e.g. shutdown or well intervention).
Drains and Vents	All hydrocarbon depressurising, venting and relief devices are connected to the collection system and routed to the Drain Vessel for liquid removal prior to atmospheric discharge through the vent tip. Closed drain piping from the Pig Launcher and Fuel Gas Knockout Drum are also routed to the vent system for liquid removal in the drain vessel. The Drain Vessel not only accumulates liquid from equipment/piping maintenance drainage but also acts as a vent knockout drum separating liquid from gas released during blowdown. Liquid collected in the drain vessel is pumped to the Otway Gas Pipeline by the two drain pumps operating in lead/lag mode. The gas disposal system is required to safely collect and dispose of fluids released during continuous operation, pressure relief (including a fire event), maintenance depressurisation activities and Emergency Shutdown initiated blowdown. Atmospheric venting was selected over flaring because of its inherent simplicity and reliability. The platform has no interconnected open drains system. A collection pan with local isolation valve has been provided should a liquid release during maintenance or operational activities occur. These local isolation valves are normally closed during operation and maintenance.
Chemical injection	MEG distribution system: The MEG Pipeline provides MEG and corrosion inhibitor to protect the Otway Gas Pipeline. A MEG injection system controls and monitors the supply of hydrate and corrosion inhibitor delivered to the process.

Utility	Description
	Methanol: Methanol is used for the initial start-up of the Geographe wells and is injected at the subsea wellheads via the main umbilical. The methanol injection system on the wellhead platform consists of a methanol storage/transfer tank, a single pump, and injection piping. This injection system feeds into the umbilical via the Topside Umbilical Termination unit. Other chemicals: Chemical injection may be required for the following: Scale inhibitor injection. Batch dosing of corrosion inhibitor into the Otway Gas Pipeline during V-jet pigging If required, temporary tanks would be connected to the MEG injection system via drain points.
Service water	The service water system receives and stores fresh water for process wash-down, personnel washing purposes and safety shower.
Heating, ventilation and air conditioning systems	Temperature in the equipment control room is controlled using Heating, Ventilation and Air Conditioning systems. In the event that the ventilation system shuts down whilst the Platform is unattended the ventilation system and the Subsea Power and Control Unit are equipped with a remote reset facility which enables remote re-start from the Otway Gas Plant.
Stored Chemicals and Other Hazardous Substances	Table 3 details the main hazardous substances and typically inventories stored on platform.

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

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

2.3.2 Otway Pipeline System

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

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

Basic design aspects of the Otway Pipeline System are detailed in Table 4 with detailed information in the Otway Pipeline System Safety Case (CDN/ID 17265477), which also provided information regarding the design and operating philosophy.

The Otway Gas Pipeline and the MEG Pipeline are detailed in Section 3.4 of the EP.

Table 4. Basic Design Aspects of the Otway Pipeline System

Aspect	Pipeline	MEG
Material	Duplex SS and Carbon steel	Carbon steel
Diameter	508 mm	114.3 mm
Wall thickness	Duplex section: 18.5mm CS Section: 17.3 mm HDD: 19.1 mm	6.4 mm except Riser & HDD: 7.9 mm
Design pressure	15.5 MPag	22.0 MPag
Design maximum temperature	80oC	21oC
Maximum flow rate	220MMsfd (raw gas)	N/A

2.3.3 Geographe and Thylacine Subsea Systems

An overview of the Geographe and Thylacine Subsea Systems are provided in the following section, and detailed in Section 3.4.3 of the EP.

2.3.3.1 Geographe System

The Geographe subsea infrastructure consists of the following major components:

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

2.3.3.2 Thylacine System

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

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

2.3.3.3 Subsea Production Wells

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

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

2.3.3.4 Emergency Shutdown and Isolation Systems

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

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

2.3.4 Suspended Wells and non-operating Flexible Flowline

An overview of suspended wells and non-operating flexible flowline is provided in the following section and detailed further in section 3.4.4 of the EP.

- The G-1 well was drilled in June 2001 discovering the Geographe field. It was completed with 7" liner across the target reservoir
- The G-3 well was drilled between May and November 2012. The G-3 well is suspended at the surface casing shoe
- The T-1 well was drilled in May 2001 discovering the Thylacine field. It was completed with 7" liner across the target reservoir
- Beach is currently developing a strategy to permanently plug and abandon and decommission the G-1, G-3 and T-1 wells to international best practice
- A General Visual Inspection with ROV will be undertaken on the G-1, G-3 and T-1 wells with a maximum duration of 2 years between inspections until the wells are permanently plug and abandoned.
- Beach is planning to commence permanent well plug and abandonment including removal of the wellheads from seabed no later than the end of 2026
- The Artisan-1 well is a vertical exploration well drilled in February 2021

During the commissioning of the new 10" flexible flowline between the Diverless Skid and the subsea manifold the flowline burst. The flowline was being pressure tested with mono-ethylene glycol and seawater, which was released to the sea. The flowline did not carry any hydrocarbons at any time.

The 10" flowline was replaced by an 8" flowline to allow production from the subsea wells. A campaign proposed for 2024 will remove all of the 10" flowline that can safely be recovered. It is estimated that approximately 4km of the flowline will be recovered with two small sections being left in-situ. These sections are located at the Diverless Skid (approximately 40 m of flowline) and TN-1 manifold (approximately 35 m of flowline). The flowline left in-situ will be added to CMMS and will be decommissioned.

2.3.5 Infrastructure Inventory and Status

Table 5 provides an inventory of the main infrastructure components for the Otway offshore operations and their status at February 2023.

Table 5. Otway Offshore Operations Infrastructure Inventory and Status

Infrastructure	Title	Status
Wells		
Artisan-1 (A-1)	Vic/P43	Suspended
Geographe-1 (G-1)	Vic/L23	Suspended
Geographe-2 (G-2)	Vic/L23	Operational
Geographe-3 (G-3)	Vic/L23	Suspended
Geographe-4 (G-4)	Vic/L23	Operational
Geographe-5 (G-5)	Vic/L23	Operational

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

Infrastructure	Title	From	To	Status
Flowlines				
Geographe Flexible Flowline	Vic/L23	Geographe Subsea Heat Exchange	Geographe Subsea Valve Skid	Operational
Export Pipeline Tie-in Spool	T/L2	Thylacine DN500 Production Riser	Otway Gas Export and piggybacked MEG Pipelines	Operational
MEG S Pipeline Tie-in pool	T/L2	Thylacine DN100 MEG Riser	Otway Gas Export and Piggybacked MEG Pipelines	Operational
Otway Gas Export and piggybacked MEG Pipelines	Vic/L23 Vic/PL36 Vic/PL36(V)	Thylacine Platform Tie-in Spools	HDD Entry (interface with Onshore Pipelines)	Operational
Cooler Spool	Vic/L23	Geographe Subsea Manifold Cooler	Geographe Subsea Heat Exchange	Operational

Infrastructure		Title	Status	
Rigid spool including wet gas meter	Vic/L23	G-2 well	Geographe Subsea Manifold Cooler	Operational
Rigid spool including wet gas meter	Vic/L23	NA	NA	Recovered
Rigid spool including wet gas meter	Vic/L23	G-4 well	Geographe Subsea Manifold Cooler	Operational
Rigid spool including wet gas meter	Vic/L23	G-5 well	Geographe Subsea Manifold Cooler	Operational
Geographe Production Tee Rigid Spool	Vic/L23	Geographe Tee	Geographe Subsea Valve Skid	Operational
Geographe MEG Tee Rigid Spool	Vic/L23	Subsea Valve Skid	Geographe Tee	Operational
Thylacine DN500 Production Riser	T/L2	Thylacine Export Pipeline Tie-in Spool	Topside pipework	Operational
Thylacine DN100 MEG Riser	T/L2	Topside pipework	MEG Pipeline Tie-in Spool	Operational
Thylacine DN200 Production Riser	T/L2	N/A	Topside pipework	Operational
Thylacine Diverless Interface Skid Production Spool	T/L2	T-DIS	Thylacine DN200 Production Riser	Operational
Thylacine Diverless Interface Skid Production Spool	T/L2	T-DIS	Thylacine DN200 Production Riser	Operational
Thylacine Diverless Interface Skid MEG Spool	T/L2	Thylacine DN100 MEG Riser (tie-in branch)	Thylacine Diverless Interface Skid	Operational
Thylacine North-1 Flexible Flowline	T/L2	Thylacine North-1 Manifold	Thylacine Diverless Interface Skid	Operational
Thylacine North-2 Flexible Flowline	T/L2	Thylacine North-2 FLET	Thylacine North-1 Manifold	Operational
Thylacine West Flexible Flowline	T/L2	Thylacine North-2 FLET	Thylacine North-1 Manifold	Operational
Thylacine Subsea Umbilical – 10” flowline	T/L2	Thylacine Diverless Skid	Thylacine Manifold	Not operating

Infrastructure		Title	Status	
Rigid spool including wet gas meter	T/L2	TN-1 well	Thylacine North-1 Manifold	Operational
Rigid spool including wet gas meter	T/L2	TN-2 well	Thylacine North-2 FLET	Operational
Rigid spool including wet gas meter	T/L2	TW-1 well	Thylacine West FLEM	Operational
Rigid spool including wet gas meter	T/L2	TW-2 well	Thylacine West FLEM	Operational
Umbilicals				
Geographe Infield Umbilical (complete with Subsea Distribution Unit SDU-500 and Umbilical Termination Assembly UTA-600)		Geographe Field (SDU-500)	Geographe Tee Approach (UTA-600)	Operational
Geographe Main Umbilical (complete with Umbilical Termination Assemblies UTA-500A and UTA-500T)		Thylacine-A Platform (UTA-500A at Platform Approach)	Geographe Wells Approach (UTA-500T)	Operational
G-2 Flying leads	Vic/L23	G-2 well	Geographe Subsea Distribution Unit	Operational
G-3 Flying leads (P/C EFLs only, WGM EFL recovered)	Vic/L23	G-3 well	Geographe Subsea Distribution Unit	Operational
G-4 Flying leads	Vic/L23	G-4 well	Geographe Subsea Distribution Unit	Operational
G-5 Flying leads	Vic/L23	G-5 well	Geographe Subsea Distribution Unit	Operational
Pipeline Corrosion Monitor (PCM-1, PCM-2)	Vic/L23	Located within Export Pipeline		Not operating
PCM-1 Electrical flying lead	Vic/L23	N/A	N/A	Recovered
PCM-2 Electrical flying lead	Vic/L23		PCM-2	Not operating
Geographe SDU Flying leads	Vic/L23	Main Umbilical Termination Assembly	Subsea Distribution Unit	Operational
Geographe SVS Electrical flying leads	Vic/L23	Infield Umbilical Termination Assembly	Subsea Valve Skid	Operational

Infrastructure		Title	Status	
Thylacine-A (TA) Umbilical complete with TA-SDU	T/L2	Thylacine-A Platform	TA-SDU	Operational
Thylacine North-1 (TN-1) Umbilical complete with TN-1 SDU and TN-1 Umbilical Termination Head (UTH)	T/L2	TA-SDU	TN-1 Well Site (TN-1 SDU)	Operational
Thylacine North-2 (TN-2) Umbilical complete with TN-2 UTA and TN-2 UTH	T/L2	TN-1 SDU	TN-2 Well Site (TN-2 UTA)	Operational
Thylacine West (TW) Umbilical complete with TW SDU and TW UTH	T/L2	TN-1 SDU	TW Well Site (TW SDU)	Operational
TN-1 Flying Leads	T/L2	TN-1 SDU	TN-1 well	Operational
TN-2 Flying Leads	T/L2	TN-2 UTA	TN-2 well	Operational
TW-1 Flying Leads	T/L2	TW SDU	TW-1 well	Operational
TW-2 Flying Leads	T/L2	TW SDU	TW-2 well	Operational
TN-1 UTH Electrical Flying Leads	T/L2	TA-SDU	TN-1 UTH	Operational
TN-2 UTH Electrical Flying Leads	T/L2	TN-1 SDU	TN-2 UTH	Operational
TW UTH Electrical Flying Leads	T/L2	TN-1 SDU	TW UTH	Operational

2.4 Activities that have the Potential to Impact the Environment

The planned activities covered within the scope of this EP can potentially result in environmental aspects, that could lead to impacts on receptors. Table 6 identifies the planned emissions, discharges, and disturbances covered in the EP.

Table 6: Planned Emissions, Discharges and Disturbances

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

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

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

2.5 Decommissioning

Decommissioning of the Otway Gas Development will be undertaken in accordance with the relevant Commonwealth and Victorian State regulatory requirements in force at the time of decommissioning or as described in an approved decommissioning EP. In accordance with EPBC referral 2002/621 (Condition 5) a decommissioning plan will be submitted for approval prior to decommissioning of any components associated with the development (i.e. the platform, wells, flowlines or any associated infrastructure).

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

2.5.1 Decommissioning Planning Process

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

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

2.5.2 Decommissioning Environmental Approvals

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

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

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

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

2.5.3 Maintaining Inventory

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

2.5.4 Plug and Abandonment of Suspended Wells

Beach is currently planning a campaign to permanently plug and abandon (P&A) the two suspended wells in the Otway Development. The P&A of these wells will be part of a separate EP, with the activity anticipated to commence in 2025.

3 Description of the Environment

The existing environment is an area defined where potential changes to ambient environmental conditions occur due to planned activities or unplanned events associated with the Otway Gas Development operations.

In accordance with the OPGGS(E)R and OPGSS Regulations (Vic), the existing environment that may be affected by the activity, including the possible values and sensitivities are identified in the following sections.

3.1 Conservation Values and Sensitivities

Conservation values and sensitivities are identified within the planning and operational area from Protected Matters Search Tool (PMST) Reports, referenced material, and relevant person consultation.

3.1.1 World Heritage Areas

There were no World Heritage Areas identified in the operational and planning area.

3.1.2 Australian Marine Parks

No Australian Marine Parks (AMP) were identified within the operational but 4 were identified within the planning area (Apollo, Beagle, Franklin, and Zeehan AMPs).

All the AMPs (excluding a Section of the Zeehan Marine Park) are classified as International Union for Conservation of Nature (IUCN) VI – Multiple Use Zone. A wide range of sustainable activities are allowed within IUCN VI – Multiple Use Zone, if they do not significantly impact the benthic (seafloor) habitats or have an unacceptable impact on the values of the area. Some activities allowed in the area include commercial fishing, general use, recreational fishing, defence, and emergency response. However, commercial fishing requires approval from the Director of National Parks.

The Zeehan AMP also has an IUCN VI – Special Purpose Zone, which allows for limited mining and low-level extraction of natural resources.

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

3.1.3 National Heritage Places

Two places of National Heritage were identified within the planning area and one within the operational area. These are:

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

The Australian Heritage Council found the Great Ocean Road and its scenic environs road from Torquay to Allansford, a journey of 242 kms, as a place of outstanding national heritage significance.

The Western Tasmania Aboriginal Cultural Landscape represents the best evidence of an Aboriginal economic adaptation which included the development of a semi-sedentary way of life with people moving seasonally up and down the north west coast of Tasmania.

3.1.4 Commonwealth Heritage Places

No Commonwealth Heritage Places were identified within the operational area. Two places of Commonwealth Heritage were identified within the planning area (Cape Wickham Lighthouse and Wilsons Promontory Lighthouse).

3.1.5 Maritime Archaeological Heritage

There are over 200 historic wrecks (over 75 years old) in the planning area, but none have a protection zone (DTP 2023). There is also no identified underwater cultural heritage within the operational area.

3.1.6 Wetlands of International Importance

No Wetlands of International Importance were identified within the operational area, but one was identified within the planning area (Lavinia Ramsar-listed wetlands).

The Lavinia Ramsar site is located on the north-east coast of King Island, Tasmania. The site is an important refuge for a collection of regional and nationally threatened species, such as the orange-bellied parrot. Artefacts of Indigenous Australian occupation have been observed on King Island that pre-date the last ice age. There are ten critical components and processes identified in the Ramsar site: wetland vegetation communities, regional and national rare plant species, regional rare bird species, King Island scrubtit, orange-bellied parrot, water and sea birds, migratory birds, striped marsh frog and the green and gold frog.

3.1.7 Nationally Important Wetlands

No Nationally important wetlands were identified within the operational area, but nine were identified within the planning area. These wetlands are:

- Aire River/Lower Aire River Wetlands – support large numbers of water birds and act as a drought refuge for wildlife.
- Lavinia Nature reserve – mentioned above (Internationally Important Wetlands).
- Princetown – extensive beds of Common Reed and Beaded Glasswort support large number of water birds, recreational.
- Shallow Inlet Marine and Coastal Park – high value as habitat for migratory waders and other shorebirds, supports tourism and recreational activities, and Indigenous artefacts (middens) found along the coast west of Shallow Inlet.
- Western Port – high value for wetland for its ecological, recreational, tourist, scientific, education, cultural, and scenic features.

The following wetlands have no connection to the ocean and would not be impacted by unplanned events associated with the activity, such as a spill, and not further described.

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

3.1.8 Victorian Protected Areas

There were no Victorian marine protected area and one terrestrial protected area identified within the operational area (Port Campbell National Park).

Seven marine protected areas were identified within the planning area (Figure 3) and include:

- Bunurong Marine National Park managed under Bunurong Marine National Park Management Plan (Parks Victoria 2006a) – Socio-economic, ecological, and cultural values (high diversity of fauna and flora species and important habitat for threatened species).
- Marengo Reefs Marine Sanctuary managed under the Marengo Reefs Marin Sanctuary Management Plan (Parks Victoria 2007a) -environmental, cultural, and social values (high diversity of algal, invertebrate and fish species, and Indigenous places and objects).
- Point Addis Marine National Park 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 -environmental, cultural, and social values for the parks and sanctuaries.
- Shallow Inlet Marine and Coastal Park – a Nationally Important Wetland, description above.
- The Arches Marine Sanctuary is managed in conjunction with the Twelve Apostles Marine Park und the Twelve Apostles Marine National Park and The Arches Marine Sanctuary – ecologically significant, supporting habitats and a diverse range of sessile invertebrates.
- Twelve Apostles Marine National Park is managed in conjunction with The Arches Marine Sanctuary under the Twelve Apostles Marine National Park and The Arches Marine Sanctuary Management Plan (Parks Victoria 2006b) and is classified as IUCN II – environmental, cultural and social values.
- Wilsons Promontory Marine National Park 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) – key environmental, cultural, and social values (abundance and diverse marine flora and fauna, important breeding sites, Indigenous places of cultural significance).

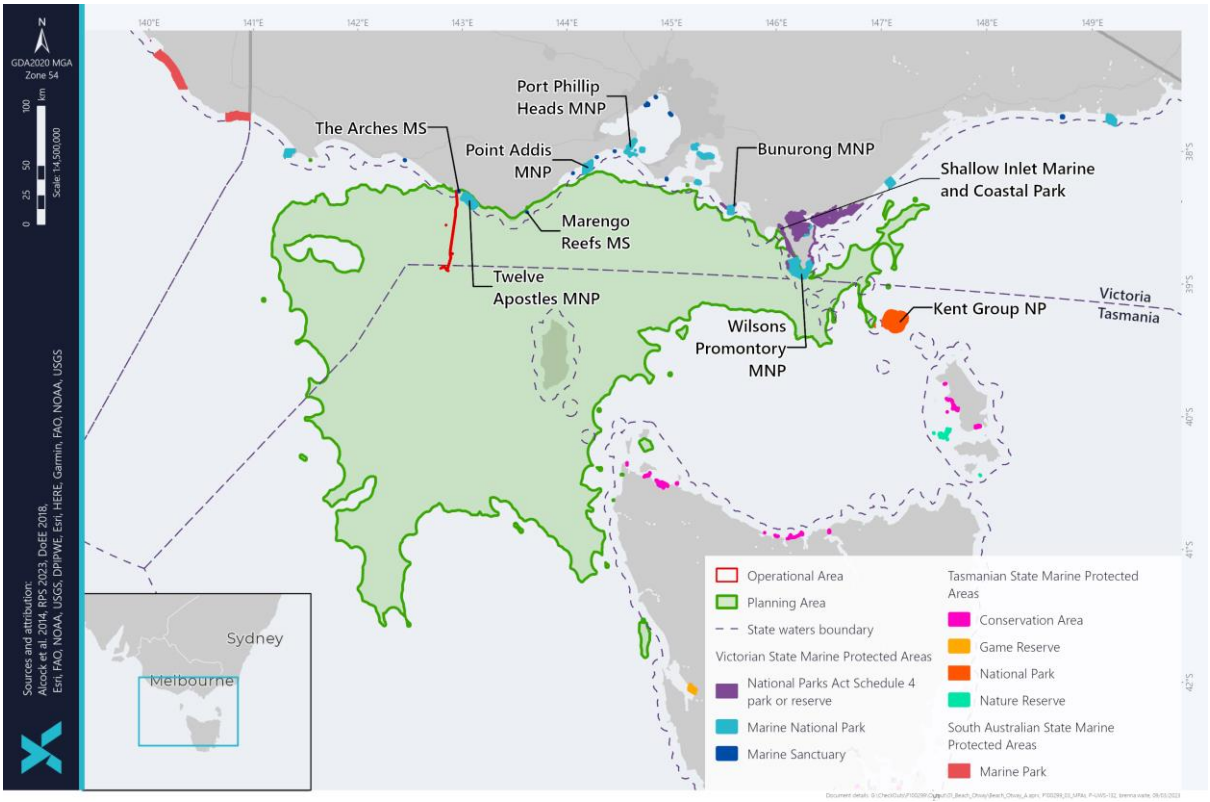

Figure 3: State Marine Protected Areas within the Planning Area

The following Victorian terrestrial protected areas were identified within the planning area (Figure 4) to potentially be affected by shoreline oil:

- Aire River Heritage River – located in the Otway region
- Bay of Islands Coastal Park – coastal park is protected under the Port Campbell National Park and Bay of Islands Coastal Park Management Plan (Parks Victoria 1998).
- Cape Liptrap Coastal Park – protected under the Cape Liptrap Coastal Park Management Plan (Parks Victoria 2003), which have environmental, cultural, and social values.
- Great Otway National Park – protected under the Great Otway National Park and Otway Forest Park Management Plan (Parks Victoria and DSE 2009) and have environmental, cultural, and social values.
- Phillip Island Nature Park – Philip Island is a Biologically Important Area (BIA) for the little penguin, with breeding and foraging sites present (DCCEEW 2023b) there is no management plan.
- Port Campbell National Park – present a collection of waves sculptured rock formations and home to various fauna, including the little penguin, short-tailed shearwater, and various whale species (Parks Victoria 2019b).
- Wilsons Promontory National Park including South Wilsons Promontory and Wilsons Promontory Islands – managed under the Wilsons Promontory National Park Management Plan and identifies

key environmental, social, and cultural values (contains sites of State and regional significance) (Parks Victoria 2002).

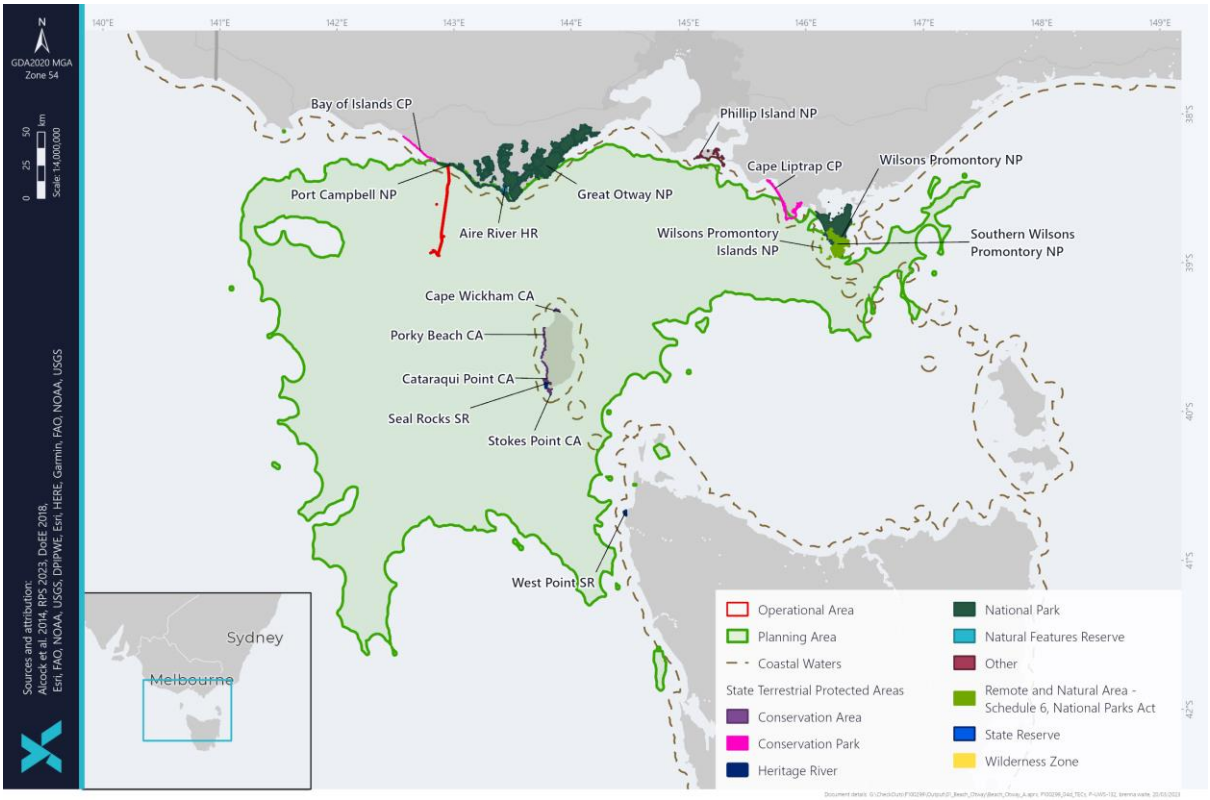

Figure 4: State Terrestrial Protected Areas within the Planning Area

3.1.9 Tasmanian Protected Areas

No Tasmanian marine or terrestrial protected areas were identified within the operational area.

One Tasmanian marine protected area was identified within the planning area (Kent Group National Park) (Figure 3). The Kent Group National Park is made up of islands and islets and are an important refuge for seabirds and a sanctuary for the Australian fur-seals.

The following terrestrial protected areas were identified within the planning area (Figure 4) to be potentially affected by shoreline oil:

- Cape Wickham Conservation Area – designated as IUCN Category V, which is protected landscape/seascape. There is no management plan.
- Cataraqui Point Conservation Area – designated as IUCN Category V and no management plan in place.
- Porky Beach Conservation Area – designated as IUCN Category V and no management plan in place.
- Seal Rocks State Reserve – designated as IUCN Category III and no management plan in place.
- Stokes Point Conservation Area – is an IUCN Category V and has no management plan.

- West Point State Reserve – is an IUCN Category V with no management plan.

3.1.10 Key Ecological Features

Key Ecological Features (KEFs) were identified using the PMST Report and are considered to be of regional importance for the region's biodiversity or ecosystem function and integrity of a Commonwealth Marine Area.

The West Tasmanian Marine Canyons KEF was identified within the operational are. The KEF is at least 15 km from the operational area (Figure 5).

The following KEFs were identified within the planning area:

- Bonney Coast Upwelling - area of enhanced pelagic productivity and has high aggregations of marine life (DoE 2023l).

- West Tasmanian Marine Canyons - greatest density of canyons within Australian waters where 72 submarine canyons have incised a 500 km-long section of slope (Heap & Harris 2008) supporting a diversity of sponges and high fish abundance.

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

- Shelf Rocky Reefs and Hard Substrates - 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.

- Bass Cascade - refers to the "underwater waterfall" effect due to the northward flow of Bass Strait waters in winter, which are more saline and slightly warmer than surrounding Tasman Sea waters. This event causes nutrient rich waters to rise, increasing primary productivity.

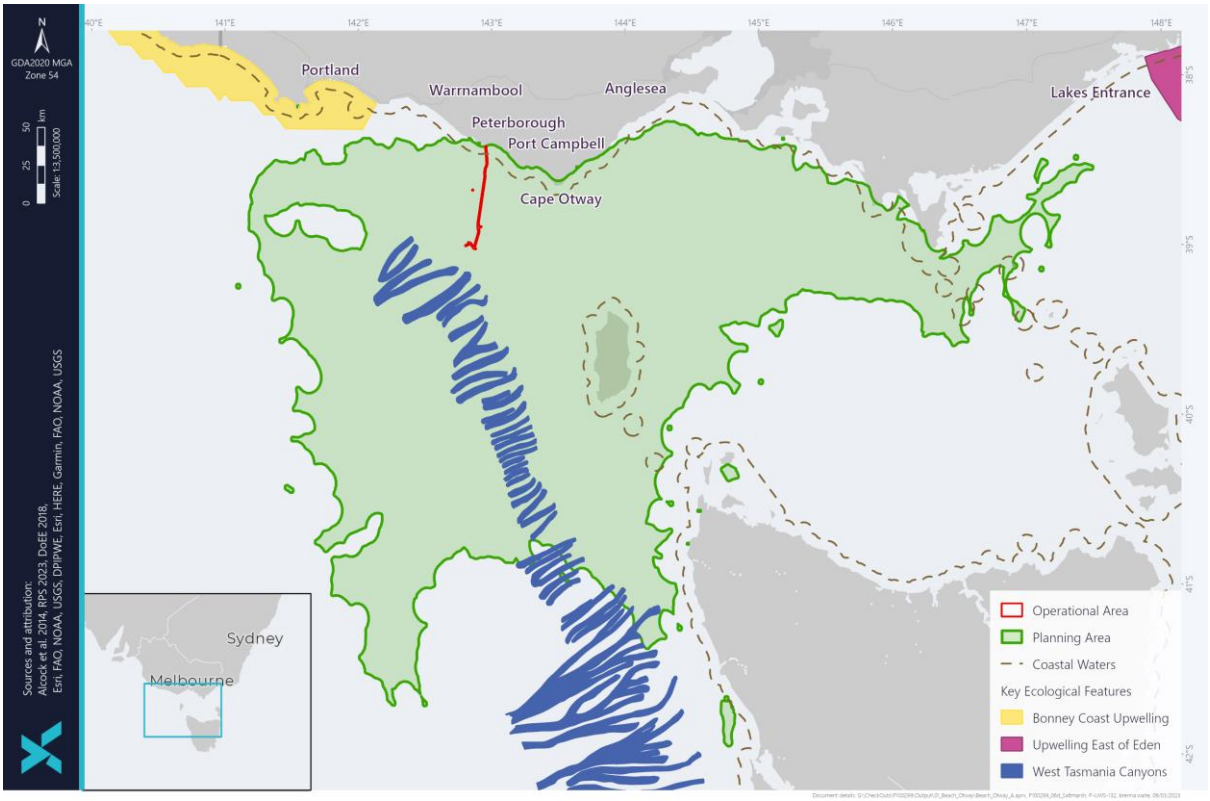

Figure 5: Key Ecological Features within the Planning area

3.2 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.

3.2.1 Geomorphology

The south-eastern section of Australia's continental margin comprises the Otway Shelf and the Bonney Coast, Bass Strait, and the western shelf of Tasmania. The Otway continent margin is a swell-dominated, open, cool-water, carbonate platform (Boreen et al. 1993). The Otway continental margin was divided into five depth related zones – shallow shelf, middle shelf, deep shelf, shelf edge and upper slope.

The planning area is within the five zones, while the operational areas is within two (shallow and middle shelf).

Table 7 - Table 10 provides a summary of the seabed morphology and benthic assemblages.

Table 7: Thylacine to Geographe seabed morphology and benthic assemblages (CEE Consultants Pty Ltd 2003)

Depth (m)	Seabed morphology	Benthic assemblage
92	High profile reef stone with deep sand gutters.	Divers, high density sessile: sponge, coral dominated crinoids common and mobile species.

Depth (m)	Seabed morphology	Benthic assemblage
88	Low profile areas of high-profile limestone ridges, incomplete sand veneer.	Diverse, high density sessile: sponge dominated and mobile species.

Table 8: Geographe to Flaxman's Hill seabed morphology and benthic assemblages (CEE Consultants Pty Ltd 2003)

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

Table 9: Geographe to Rifle Range seabed morphology and benthic assemblages (CEE Consultants Pty Ltd 2003)

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

Depth (m)	Seabed morphology	Benthic assemblage
70	(Pock marks) Data not documented.	Medium density, sessile: sponge, dominated
63	Corse gravel to fine sand	High density sessile: micro algae dominated

Table 10: Nearshore seabed morphology and benthic assemblages (CEE Consultants Pty Ltd 2003)

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

3.2.2 Metocean Conditions

Metocean conditions of the Bass Strait and Otway Basin were identified through experimental surveys conducted by beach and relevant literature. Results show:

- Temperate climate, characterised by cold, wet winters and warm, dry summers.
- Cold fronts creating a sustained west to south-westerly winds within the Otway.
- The tides are semi-diurnal with some diurnal inequalities, resulting in north-east/south-west tidal currents.
- Ocean currents in the Bass Strait are primarily driven by tides, winds, and density-driven flows with the East Australian Current one of the four major currents to influence the conditions and biodiversity in the area.
- The Bass Strait is also a high-energy environment exposed to frequent storms and significant wave heights.
- The average surface temperature ranges from 14°C in winter to 21°C in summer with upwelling (subductions of cooler nitrite-rich water) occurring mid to late summer.
- Natural sea sound sources are dominated by wind noise, but also include rain, biological and earthquake noises, with man-made underwater sound sources comprising of shipping, vessel traffic, offshore oil and gas activities, and petroleum seismic surveys (McCauley and Duncan 2001).
- Water quality will be typical of the offshore marine environment, characterised by high water quality with low background concentrations of trace metals and organic chemicals.
- Sediments had a high ORP and low/undetectable levels of toxicants indicating an unmodified seabed environment.
- Air quality show that most GHGs have continuously increased in concentrations due to anthropogenic causes such as fossil fuel consumption and agricultural practices (CSIRO 2017).

3.3 Ecological Environment

The ecological environment in the Bass Strait and Otway Basin were identified through literature searches to identify flora and fauna species known or likely associated within the operational and planning area.

3.3.1 Benthic Habitats and Species Assemblages

The Otway continental margin is dominated by medium to course-carbonate sands with areas of low relief exposed limestone.

The intertidal and subtidal areas consist of unvegetated soft sediment. However, factors such as depth, light, temperature, and sediment type can influence biodiversity and productivity of soft sediment habitat.

There are five different habitats identified within the Otway continental margin, which support a diverse array of benthic species. These habitats include soft sediment, seagrass meadows, benthic microalgae, coral, and carbonate sands exposed limestone.

There are three locations of seagrass meadows known to be present within the planning area, including Corner Inlet, Port Philp Bay, and Western Port Bay. Seagrass meadows are important in stabilising seabed sediments, and providing nursery grounds for fish and crustaceans, and a protective habitat for the juvenile fish and invertebrates species (Huisman 2000; Kirkham 1997).

Within the planning area, seagrass and benthic microalgae are present along the Victorian coastline (Figure 6).

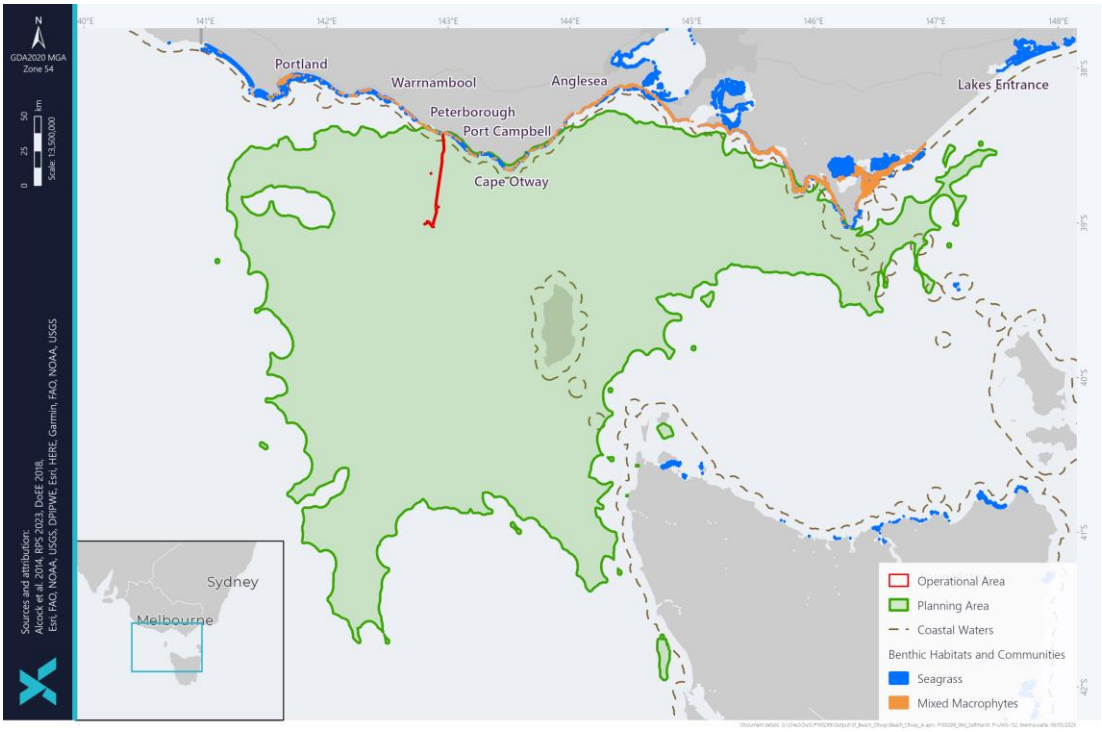

Figure 6: Presence of Seagrass (and mixed macrophyte) Habitat within the Planning Area

Benthic microalgae are present in areas where sunlight reaches the sediment surface and can be affected by 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.

There are two main species of Bull Kelp, these are *D. potatorum* and *D. amatheiae* located offshore Victoria and Tasmania. These kelp species are inhabited by a diverse array of epifauna and infauna invertebrates and can become important nursery and sanctuary areas for fish, crustaceans, and other fauna. The kelp are known to shelter 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*).

Corals are not a dominant habitat within the operational area and planning area but are present around Wilsons Promontory National Park and Cape Otway. 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.

Carbonate sands are documented in the Otway middle shelf and support benthic fauna dominated by bryozoans, infaunal echinoids, and assemblages of sponges (Boreen et al. 1993). Demersal fishes are likely to be associated with carbonate sands on the middle and inner shelf include eastern stargazer (*Kathetostoma laeve*), elephant shark (*Callorhynchus milli*), greenback flounder (*Rhombosolea taoarina*), gummy shark (*Mustelus antarcticus*), long-snouted flounder (A*mmotretis rostraus*), saw shark (P*ristiophorus nudipinnis*), southern sand flathead (*Platycephalus bassensis*) and southern school whiting (S*illago bassensis*).

Limestone substrates are reported within the inner shelf (Boreen et al. 1993) and were comprised of sponges, encrusting and branching corailine algae, poysonellid algae, bryozoa, benthic forams, robust sarpullds, brachiopods, bivalves, gastropods, fleshy red algae, and kelp.

3.3.2 Mangroves

The mangroves in Victoria are located mostly along the sheltered sections of the coast within inlets or bays (MESA 2014). Only one species of mangrove is found in Victoria, the white/grey mangrove (A*vicennia marin*a), which is known to occur at Western Port and Corner Inlet outside the planning area.

3.3.3 Saltmarsh

Saltmarshes are found along many parts of the Victorian coast and is most extensive in Western Port Philip Bay, norther Western Port, within the Corner Inlet -Nooramunga complex, and behind the sand dunes of Ninety Mile Beach in Gippsland.

3.3.4 Plankton

There have been relatively few studies of plankton populations in the Otway and Bass Strait regions, with most concentrating on zooplankton. Zooplankton diversity was reported to be over 170 species in the eastern Bass Strait (Watson and Cahloupka 1982), while another reported only 80 species within the western and central Bass Strait (Kimmerer and McKinnon 1984). However, since plankton distribution is determined by ocean currents, such as the East Australian Current, their presence within the planning area is expected to be highly variable both spatially and temporally.

3.3.5 Invertebrates

The variety of benthic habitats in the region support a range of invertebrate communities such as sparse sponges to extensive 'thickets' of lace corals and sponges, polychaete worms and filter feeders (DNP 2013).

Other invertebrates that are known to be present within the Bass Strait and Otway Basin include:

- Large species of crustacea (lobster, prawn, and crab).
- Mollusc species (oysters, scallops, abalone, sea slug,).
- Maori octopus.
- Volutes and cowries.
- Echinoderms (sea stars, sea urchins, and sea cucumbers).

3.3.6 Threatened Ecological Communities

Five threatened ecological communities (TEC) were identified to occur within the planning area (Figure 3-5) and include:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community – assemblages of native plants, animals, and micro-organisms associated with the dynamic salt-wedge estuary systems.
- Giant Kelp Marine Forests of South East Australia – brown algae growing on rocky reefs are the foundation species of this TEC in shallow coastal marine ecological communities.
- Natural Damp Grassland of the Victorian Coastal Plains (terrestrial environment).
- Subtropical and Temperate Coastal Saltmarsh – provides extensive ecosystem services such as filtering surface water, coastal productivity, food and nutrient provisions for a wide range of adjacent marine and estuarine communities, stabilising sediments, and carbon sequestration.
- Tasmanian Forests and Woodlands dominated by black gum or Brookers Gum (*Eucalyptus ovata* / E. brookeroana) (terrestrial environment).

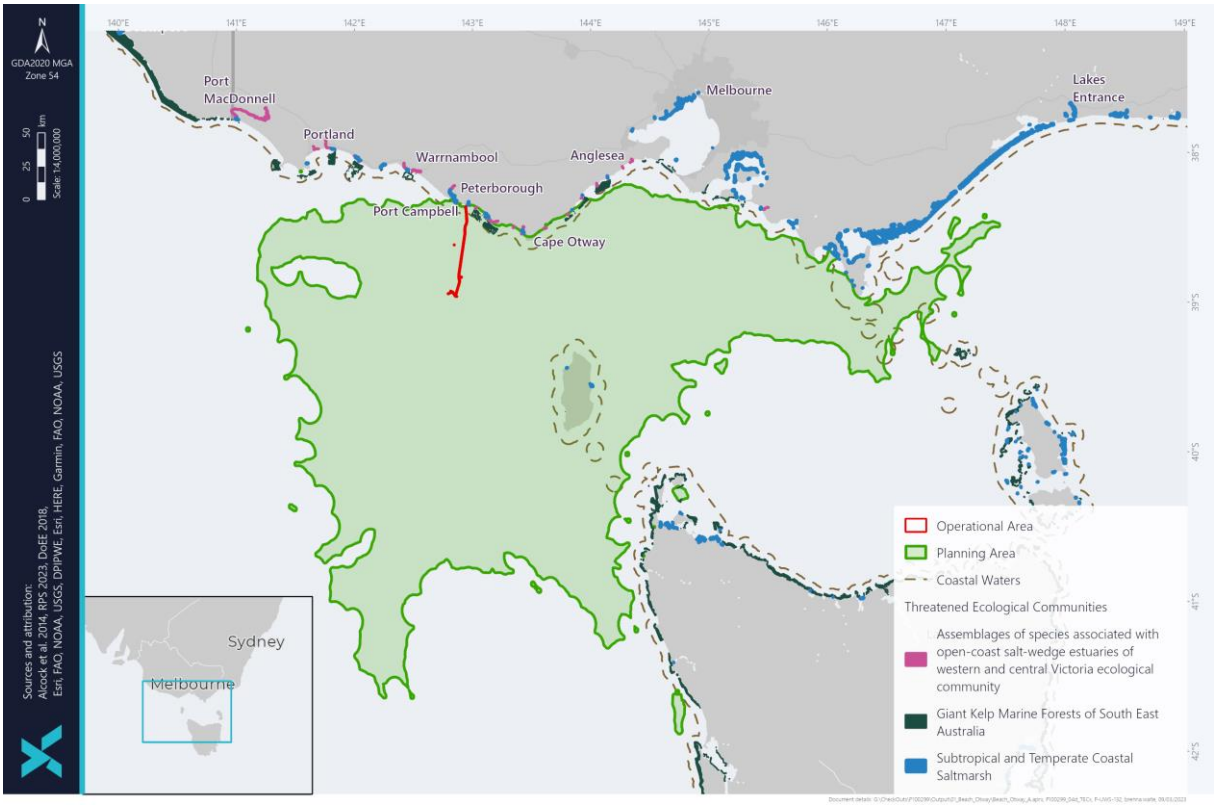

Figure 7: Threatened Ecological Communities within the Planning Area

3.3.7 Threatened and Migratory Species

Under Part 13 of *the Environment Protection and Biodiversity Conservation Act 1999* (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.

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.

There is no habitat critical to the survival of listed species within the operational area or planning area. However, the operational area overlaps with 10 bird species BIA (foraging), one fish BIA (distribution), and four cetacean BIAS (foraging, distribution, reproduction, and migration).

There is a total of 68 species listed as threatened with an additional 42 listed as migratory (terrestrial, marine or wetlands), and 70 listed as marine species possibly or known to occur within the operational and planning area. Of the total, there are 39 threatened, migratory and marine listed shark and ray species (seven threatened, two migratory and 30 marine listed), 58 threatened and migratory seabird

and terrestrial bird species (49 threatened, six migratory, and 18 marine listed), three threatened migratory and marine listed marine reptiles, 28 threatened, migratory and marine listed cetacean species (four threatened, six migratory, and 18 marine listed), and three threatened and marine listed pinniped species (one threatened and two marine listed).

The orange-bellied parrot (*Neophema chrysogaster*) (listed as critically endangered under the EPBC Act) breeds in Tasmania during summer, migrates north across the Bass Strait in autumn and spends winter on the mainland. The orange-bellied parrot may overfly the coastal waters of the operational and planning area, but they rarely land or forage out at sea.

3.3.8 Invasive/Introduced Marine species and Viruses

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

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

- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m (but up to 200 m water depths). It is thought to have been introduced in 1995 through ballast water from Japan. Well established in Port Phillip but currently not present in other Victorian locations.

- New Zealand screw shell (*Maoricolpus roseus*) – lies on or partially buried in sand, mud or gravel in waters up to 130 m deep. It can densely blanket the sea floor with live and dead shells and compete with native scallops and other shellfish for food. This species is known to be present in the Port Phillip and the Western Port region.

- European shore crab (*Carcinus maenas*) – prefers intertidal areas, bays, estuaries, mudflats and subtidal seagrass beds, but occurs in waters up to 60 m deep. It is widespread across Victorian intertidal reef and common in Western Port.

- Dead man's fingers (Codium fragile ssp. fragile) – Widespread in Port Phillip and known to inhabit San Remo and Newhaven in Westernport. It grows rapidly to shade out native vegetation and can regenerate from a broken fragment enabling easy transfer from one area to another. Attaches to subtidal rocky reef and other hard surfaces.

- Cord grass (*Spartina anglica* and *Spartina x townsendii* sp) – found at the mouth of Bass River and in drain outlets near Tooradin in Westernport. Widespread in South Gippsland including Anderson's Inlet and Corner Inlet. Invades native saltmarsh, mangroves, and mudflats, altering the mud habitat and excluding other species.

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 last confirmation of active disease in Victoria was from Cape Otway lighthouse in December 2009 (Victoria State Government, 2016).

3.4 Socio-Economic Environment

3.4.1 Coastal Settlements

There are no coastal settlements within the operational area. The nearest settlement to the operational area is Port Campbell. The operational area is within the Corangamite Shire Local Government Area (LGA) and the planning area is within the following:

- Circular Head
- Colac Otway
- Corangamite
- Glenelg
- Glennie Group
- King Island
- Moyne
- Philip Island
- South Gippsland

The larger Victorian coastal settlements within the planning area are mainly the hospitality and retail, dairy cattle farming, hospitals, and education industries (ABS 2021 census data).

The larger Tasmanian coastal settlements within the planning area are the mainly dairy and beef cattle farming, retail, hospitals, and rock lobster and crab potting industries (ABS 2021 census data).

3.4.2 Offshore Petroleum Industry

Petroleum exploration has been undertaken within the Otway Basin since the early 1960s with gas reserves, approximately 2 trillion cubic feet, discovered since 1995.

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

The Cooper Energy Casino and Henry gas fields and Casino-Henry pipeline and the Minerva gas field and pipeline are within the northern portion of the planning area.

3.4.3 Other infrastructure

Other infrastructure located within the operational and planning area include:

- The Victoria Desalination Plant – 237 km northeast of the operational area and inshore of the planning area
- The Indigo Central telecommunications cable – 19 km south of the operational area.
- Two Telstra telecommunications cables – the closest located 228 km east of the operational area within the planning area.

3.4.4 Defence Activities

Unexploded ordnance (UXO) is a by-product of past training activities undertaken by the Australian Defence Force or foreign defence forces.

The operational area is located 45 km away from another UXO zone SDG136 'Sea Dumping - Victorian Coast' (DoD 2022). However, Beach site surveys confirmed the absence of UXO within the operational area.

3.4.5 Shipping

The SEMR is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes (Figure 8). The majority of commercial shipping traffic transiting to and from Victorian ports were containers (3,682), general cargo (2,663, bulk liquid carriers (2,019), dry bulk (1,715), car carrier (1,342), bulk gas (220), other cargo (47) and livestock (9) (Ports Australia 2019).

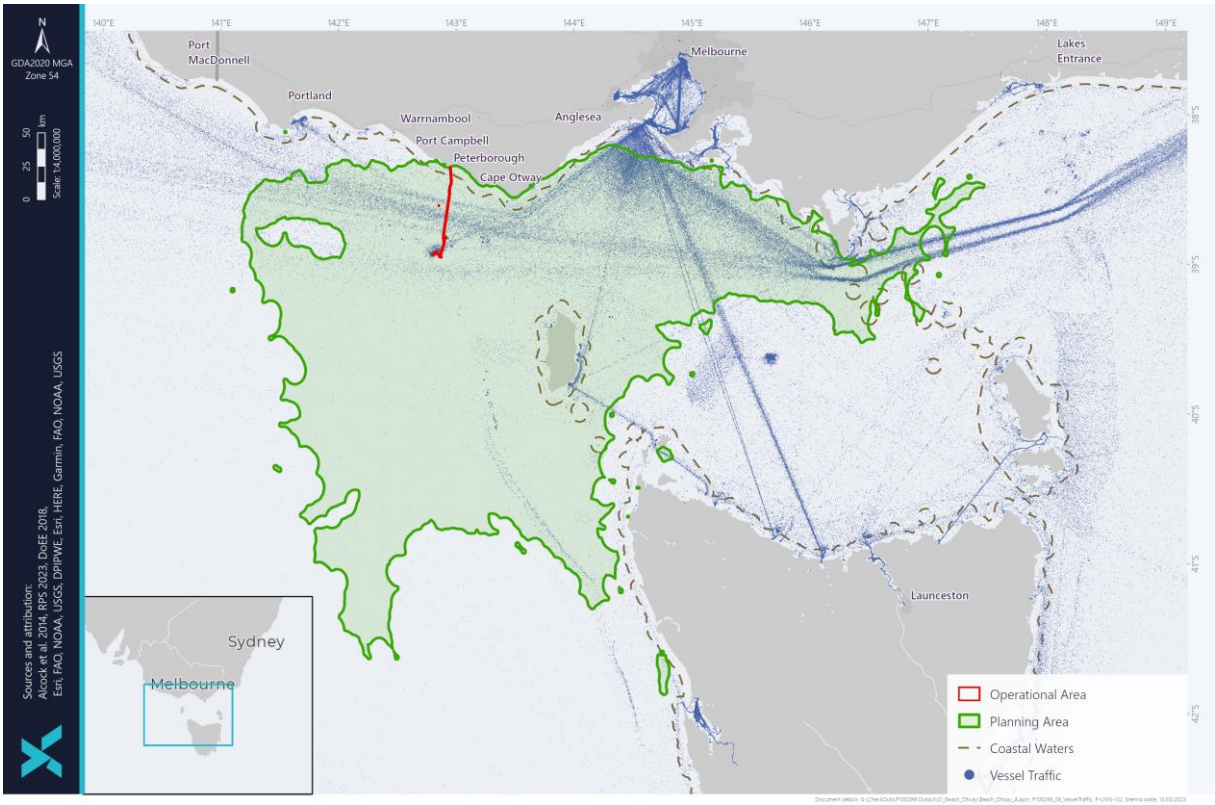

Figure 8: Vessel Traffic within the Planning Area

3.4.6 Tourism

Consultation has identified that the key areas of tourism in the region include land-based sightseeing from the Great Ocean Road and lookouts along that road, helicopter sightseeing, private and chartered vessels touring into the Twelve Apostles Marine Park, diving and fishing. Local vessels accessing the area generally launch from Boat Bay in the Bay of Islands or from Port Campbell.

3.4.7 Recreational Activities

Recreational diving occurs along the Otway coastline with diving occurring at the following sites:

- Peterborough – several shipwrecks and shore dives (Wild Dog Cove, Massacre Bay, Crofts Bay, and the bay of Islands).
- Arches Marine Sanctuary.
- Loch Ard wreck sites.

The recreational fisheries that occur within the planning area are:

- Rock lobster
- Finfish (multiple species are targeted, including sharks)
- Abalone
- Scallops
- Squid
- Pipi

Of these, active recreational fishing for rock lobster, abalone, finfish and sharks is likely to occur within the planning area. There is the potential for recreational fishing to occur within the near shore areas of the Otway Pipeline System.

3.4.8 Commonwealth Managed Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) under the Fisheries Management Act 1991 (Cth). Commonwealth commercial fisheries with jurisdictions to fish within the planning area are:

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

Of these fisheries, the Bass Strait CZSF, ETBF, SBTF, SESSF and Southern Squid Jig Fishery have catch effort within the planning area and SESSF and Southern Squid Jig Fishery have catch effort within the operational area based on ABARES reports data for fishing years 2013 – 2021 (Patterson et al. 2022, 2021, 2020, 2019, 2018, 2017, 2016, 2015 and Georgeson et al. 2014).

3.4.9 Victorian Managed Fisheries

There are ten Victorian state-managed fisheries that overlap the planning area:

- Abalone Fishery – fishing effort within the planning area.
- Bays and Inlet Fisheries - fishing effort within the planning area.
- Eel Fishery - fishing effort within the planning area.
- Giant Crab Fishery - fishing effort within the operational and planning area.
- Multi-species Ocean Fisheries – General Fishery (fishing effort within the operational and planning area) and Inshore trawl (fishing effort within the operational and planning area).
- Octopus Fishery - fishing effort within the operational and planning area.
- Pipi Fishery - fishing effort within the operational and planning area.
- Rock Lobster Fishery (western zone) - fishing effort within the operational and planning area.
- Scallop (Ocean) Fishery - fishing effort within the operational and planning area.
- Wrasse (Ocean) Fishery- fishing effort within the operational and planning area.

No data on the Abalone Fishery locations was available from VFA due to the confidential nature of the data.

3.4.10 Tasmanian Managed Fisheries

No Tasmanian fisheries occur within the operational area.

There are eight Tasmanian state managed commercial fisheries that potentially occur within the planning area:

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

Historic catch assessments indicate that Commercial Dive, Scallop and Shellfish Fisheries activities are unlikely to occur in the planning area, with fishing effort located in other areas of these fisheries.

3.4.11 Seaweed Industry

Besides Kelp Industries, other seaweed collectors in Tasmania include Kelpomix and TasKelp. There are also licenses for wild harvest of the invasive species of Undaria in Tasmania (KaiHo Ocean Treasure) and some in Victoria (Australian Seaweed Institute 2023).

The harvesting of native seaweed in Victorian marine waters is prohibited without a permit (s. 112(2) Fisheries Act 1995) and licences enabling seaweed aquaculture are not currently available in Victoria (VFA 2023a).

3.5 First Nations

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

Figure 9 details the Victorian Traditional Owners adjacent to the operational and planning areas.

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

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

Following conflict between the European colonists and the Tasmanian First Nation peoples, many were relocated to missions on Bruny Island, Flinders Island and other sites, and finally to Oyster Cove. The number of Aboriginal people diminished drastically. The Aboriginal Heritage Register (AHR) lists over 13,000 sites; however, there is no searchable database to identify any sites in the planning area.

The palawa (Tasmanian Aboriginal) people as the Traditional Owners of lutruwita (Tasmania).

This section describes the cultural heritage values broadly categorised as Aboriginal heritage within the Planning Area.

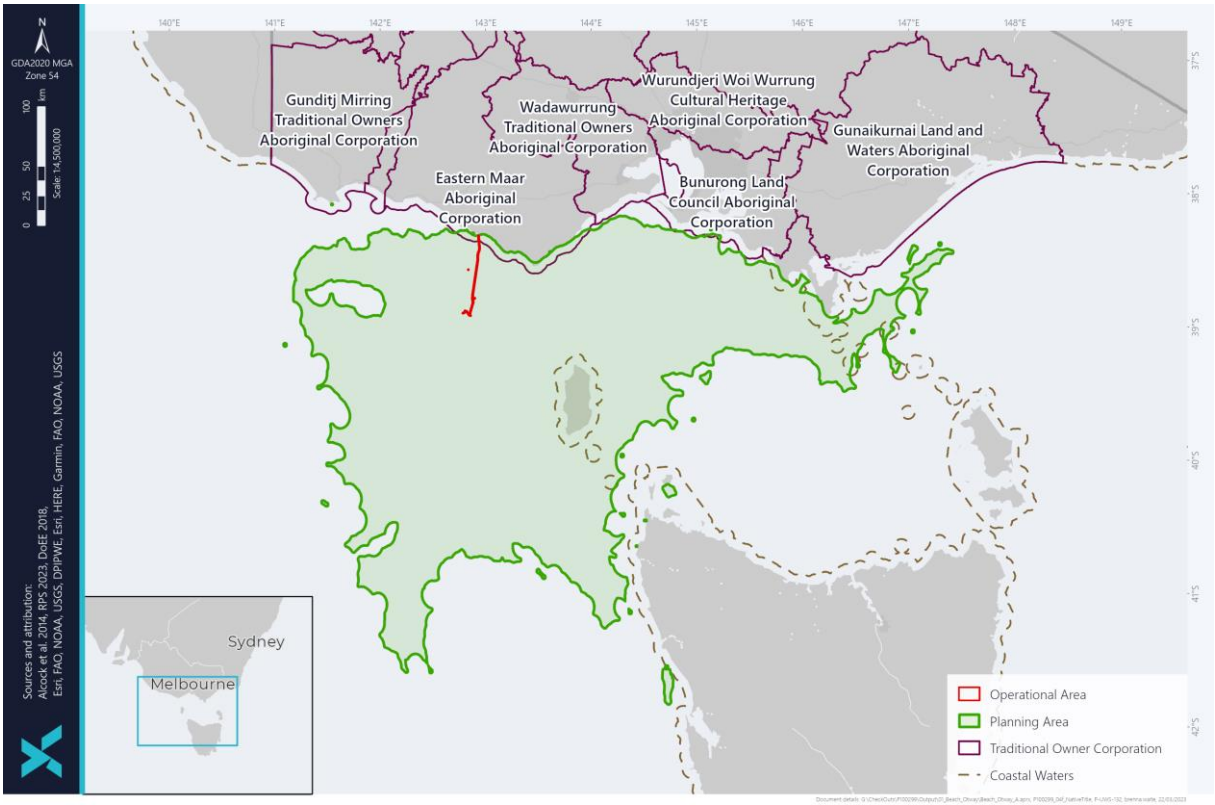

Figure 9: Victorian Traditional Owners within the Planning Area

3.5.1 Sea Country

Country is the term often used by First Nations people to describe the lands, waterways, and seas to which they are connected. The term contains complex ideas about law, place, custom, language, spiritual belief, cultural practice, material sustenance, family, and identity (AIATSIS, 2022). Sea Country also known as Saltwater Country may extend into the planning area.

First Nations people see themselves as having responsibilities and rights across the land and sea boundaries that have been put in place over the last 200 years, this includes land that was once inundated by sea, and land that now lies beneath the sea (NOO, 2002a).

According to the ABS (2021) census data, 2.9% of the population of Currie (King Island, Tasmania) identify as Aboriginal and/or Torres Strait Islander Coastal areas of southeast Australia were amongst the most densely populated regions of pre-colonial Australia. These highly populated areas provided an abundance of marine and other resources. As a result, coastal shell middens and many sacred sites, places and artefacts along the coast exist in the region. At least 17 distinct Aboriginal language groups occupied and used coastal land and seas in this region. The planning area intersects coastal areas associated with the major indigenous language groups of the Giraiwurung and Gadubanud groups (NOO, 2002a).

The Eastern Maar are Traditional Owners of southwest Victoria, and currently occupy a registered Native Title claim on the land adjacent to the operational and planning area and 100 m out to sea. Their land extends as far north as Ararat and encompasses Warrnambool, Port Fairy and other areas along the Great Ocean Road, it also stretches 100 m out to sea from low tide and therefore includes the iconic Twelve Apostles (EMAC, 2020).

3.5.2 Native Title

A search of the National Native Title Tribunal (NNTT) database identified one native title claim accepted for registration over coastal areas within the planning area (Figure 10). The claim is by the Eastern Maar people (VC2012/001), registered in 2013, and extends seaward 100 m from the mean low-water mark of the coastline (NNTT, 2016). There is currently no determination registered over the area of the claim (still active) in the National Native Title Register.

The following native titles exist outside but adjacent to the planning area:

- VCD2007/001 - Gunditjmara - Part A. Gunditj Mirring Traditional Owners Aboriginal Corporation Registered Native Title Body Corporate.
- VCD2011/001 - Gunditjmara Area C. Gunditj Mirring Traditional Owners Aboriginal Corporation Registered Native Title Body Corporate, Eastern Maar Aboriginal Corporation Registered Native Title Body Corporate.
- VCD2010/001 - Gunai/Kurnai People. Gunaikurnai Land & Waters Aboriginal Corporation Registered Native Title Body Corporate.

There are no registered claims in Tasmania.

3.5.3 Indigenous Protected Areas

The Preminghana Indigenous Protect Area (IPA) was identified as being in adjacent to where oil may come ashore within the planning area (Figure 10). No IPAs were identified in the operational area (Figure 10).

The Preminghana IPA borders Tasmania and the Southern Ocean and was dedicated an IPA in 1999. Covering 524 hectares of land in the north-west, it protects historic Aboriginal engraving sites and the endangered Preminghana daisy.

The Tasmanian Aboriginal Centre Rangers took over the management of Preminghana in 2014. Initial priorities were to understand community aspirations and to improve visitor and worker facilities.

3.5.4 Indigenous Land Use Agreements

No registered Indigenous Land Use Agreements were identified within the operational or planning areas (Figure 10).

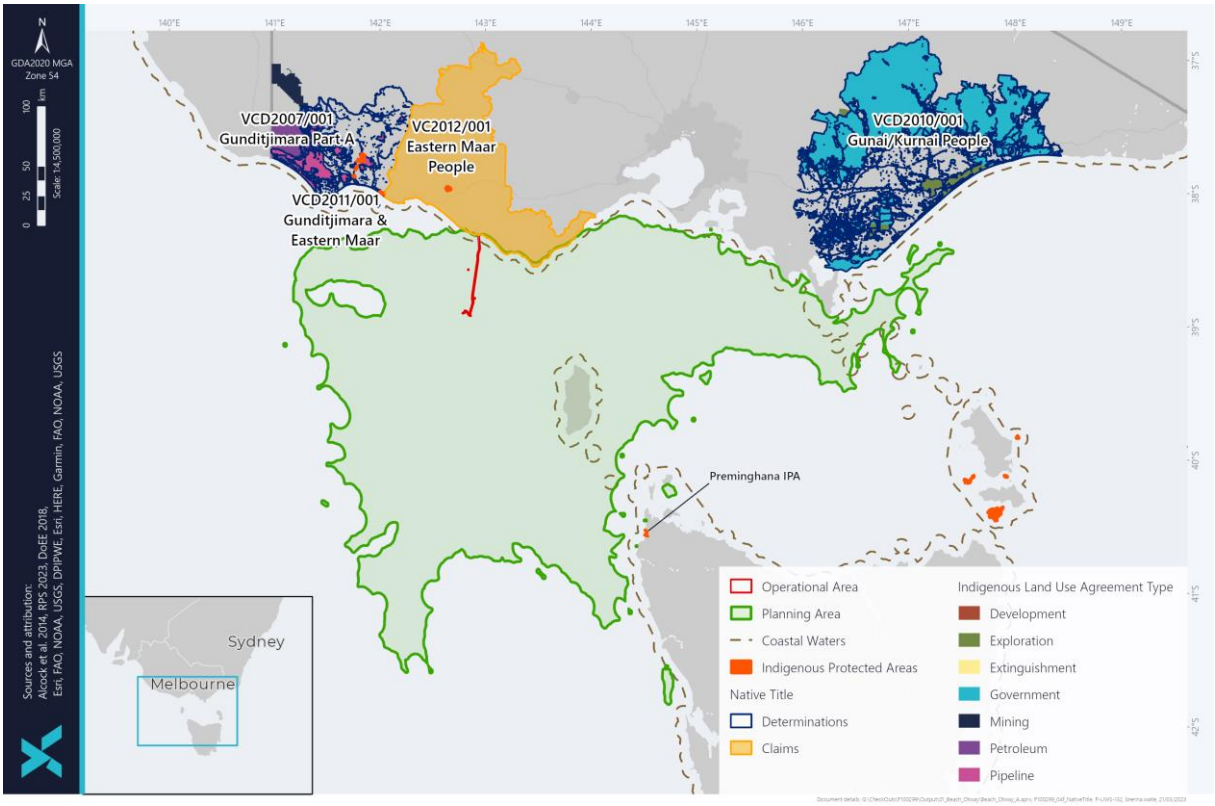

Figure 10: Native Title, Indigenous Protected Areas and Indigenous Land Use Agreements within Planning Area

4 Stakeholder Consultation

Regulation 13E(4)(viii) of the OPGGS Regulations requires the EP summary to contain details of consultations undertaken and plans for ongoing consultation.

The Otway Development commenced production in late February 2008. Woodside Energy, the titleholder at the time, undertook significant consultation with the community, non-government organisations and Government departments. Consultation has been ongoing through the change of titleholders to Origin Energy and then Lattice Energy and now Beach. Consultation with Relevant Persons has continued throughout the Otway Offshore Project, and specifically for the purpose of developing numerous EPs.

In addition, Beach has undertaken further consultation with existing and additional Relevant Persons, to ensure compliance with the appeal decision of Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193 (appeal decision) on 2 December 2022, which from this date, represents the law regarding requirements for consultation in accordance with the Environment Regulations, and NOPSEMA Guideline Consultation in the Course of Preparing an Environment Plan.

Beach also undertakes consultation in accordance with internal policies and procedures including:

- Community Engagement Policy
- Community Engagement Standard BST 10.2

4.1 Engagement Methodology

The approach Beach has undertaken for consultation for the Beach Otway Offshore Development, including the Beach Otway Offshore Operations EP is:

- Review all current Relevant Persons and identify new Relevant Persons.
- Provide a detailed information sheet and area map via email to commence the consultations (also place on Beach website).
- Provide a table of risks and management measures for those seeking additional information (also placed on Beach website).
- Place public notice advertisements in applicable regional newspapers, include QR code linking to information sheet for easy access to further information, and 1800 phone number for direct consultation.
- Respond to requests for additional information from Relevant Persons who have concerns or interests and offer direct consultation with relevant technical staff where applicable.
- Advertise and conduct regional community information sessions (several have been conducted prior to the Otway Offshore drilling campaign and more recently to provide updates).
- Allow a reasonable period of time for the Relevant Person to review and respond to any information provided, typically four weeks.
- Follow up all Relevant Persons whose functions, interests, or activities may be directly affected by the activities in the EP, via phone, email/s or in person to ensure they have received the information and verify if they have remaining questions or concerns.
- Follow up all Relevant Persons who have raised concerns about the activities in the EP and offer to meet in person or online to discuss their concerns and answer their questions.
- Ensure Relevant Persons were informed about the consultation process and how their feedback, questions and concerns were considered in the EP, including the management of sensitive information.

4.2 Summary of Stakeholder Consultation

A summary of stakeholder consultation records is provided in Table 11, or in further detail within Section 8.17 of the complete EP available on the NOPSEMA website.

Consultation undertaken prior to this time has been reported in other EPs prepared for the Otway Offshore Project, along with all Beach's accepted EPs, and can be viewed on the NOPSEMA website.

Where an objection or claim was raised by a Relevant Person, they were provided feedback as to whether the objection or claim was substantiated, how it was assessed and if any additional controls were required to manage the impact or risk to ALARP and an acceptable level. Where an objection or claim was substantiated via evidence such as publicly available credible information and/or scientific or fishing data, this was assessed as per the risk assessment process (detailed in Section 5.3) and controls applied where appropriate to ensure impacts and risks are managed to ALARP and an acceptable level.

4.3 Ongoing Consultation

Beach will continue to consult with Relevant Persons to provide activity updates and keep them informed as information becomes available. This will be done via ongoing consultation, including updates in relation to the activity and broader Otway Offshore Development via one-on-one communications, emails, and provision of information on the Beach website.

Table 11 Relevant Persons consulted for the Otway Offshore Operations EP

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
12 Apostles Helicopters & Port Campbell Heliport	3	No response received	No response, continue consultation	Functions, interests or activities not affected.	9/06/2023
3D Oil Ltd	7	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities not affected. New contact added to database.	9/06/2023
Abalone Council Australia Ltd	3	No response received	No response, continue consultation	Functions, interests or activities not affected, given assessment of environment, values and sensitivities.	9/06/2023
Abalone Council Victoria	4	No response received	No response, continue consultation	Functions, interests or activities of members are highly unlikely to be affected, as per impact assessment.	9/06/2023
Abalone Victoria Central Zone	13	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Aboriginal Land Council of Tasmania	8	No concerns raised	No concerns raised, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	21/03/2023
Allfresh Seafood	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
ANZT Fishing Company	3	No response received	No response, continue consultation	Functions, interests or activities may be affected as per assessment of potential impacts.	9/06/2023
Apollo Bay Chamber of Commerce	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Dive Centre and Surf n Fish	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Fisherman's Cooperative	6	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Apollo Bay Fishing Charters	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Landcare	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Police and Ocean Rescue	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected.	9/06/2023
Apollo Bay Surf & Kayak	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Surf Life Saving Club	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Apollo Bay Visitor Information Centre	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Atlantis Fisheries Consulting Group	3	No concerns raised	No concerns raised, continue consultation	Refer to assessments for SETFIA and SSFI.	9/06/2023
Australian Border Force - Maritime Border Command	3	No response received	No response, continue consultation	Continue to engage as per Regulation 11(A)(1)(a)	9/06/2023
Australian Coastal Society - Victorian Chapter	7	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Australian Communications and Media Authority	6	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Australian Conservation Alliance	3	No concerns raised	No concerns raised, continue consultation	Ongoing engagement as a national ENGO with a specific interest in gas.	14/03/2023
Australian Conservation Foundation	5	No response received	No response, continue consultation	Ongoing engagement as a national ENGO with an interest in gas.	21/03/2023
Australian Fisheries Management Authority	7	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities of some Commonwealth fisheries may be affected as per assessment of potential impacts. Beach has previously confirmed we have been	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
				consulting with all fishers in proposed area for the last few years. We will continue to advise relevant fishing associations and fishers as we've been doing. No further action.	
Australian Maritime Safety Authority - Joint Rescue Coordination Centre	12	No concerns raised	No concerns raised, continue consultation	Continue to engage as per Regulation 11(A)(1)(a)	9/06/2023
Australian Oceanographic Services Pty Ltd	3	No response received	No response, continue consultation	Functions, interests or activities not affected by project activities.	9/06/2023
Australian Petroleum Production and Exploration Association	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Australian Southern Bluefin Tuna Industry Association	6	No response received	No response, continue consultation	Assessment of fishing history showed minimal fishing effort in the Activity Area. Project activities since 2019 have not caused impacts in the Activity Area, now subject to PSZ exclusion. Remote likelihood, minor consequence, and low risk to fish from MDO loss of containment.	9/06/2023
Australian Wildcatch Fishing (Corporate Alliance Enterprises)	6	No response received	No response, continue consultation	Assessment of fishing history showed minimal fishing effort in the Activity Area. Project activities since 2019 have not caused impacts in the Activity Area, now subject to PSZ exclusion. Remote likelihood, minor consequence, and low risk to fish from MDO loss of containment.	9/06/2023
Aventus Consulting	3	No response received	No response, continue consultation	Consultant to Beach, included in relevant person updates for reference.	9/06/2023
Barwon Heads Association	1	No response received	No response, discontinue consultation	Group has not responded to request to share information. Functions, interests or activities not affected by project activities	14/02/2023
Beach Patrol 3280	5	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Beachport Surf Life Saving Club	3	No concerns raised	No concerns raised, continue consultation	Will continue to engage where EMBA is relevant to SA coastline.	6/03/2023
Blue Whale Study Inc	3	No response received	No response, continue consultation	Functions, interests or activities unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities and mitigations in place.	9/06/2023
Boon Wurrung Foundation	4	No response received	No concerns raised, continue updates	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	9/06/2023
Bunurong Land Council Aboriginal Corporation	17	Concerns raised	Concerns resolved, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place. Beach assured that engagement with Eastern Maar is extensive.	9/06/2023
Burrandies Aboriginal Corporation	14	Concerns raised	Concerns resolved, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place. Beach assured them there is extensive engagement with the Eastern Maar. Provided information on our work with independent whale experts and our accepted OPEP	6/04/2023
Circular Head Council	2	No response received	No response, continue consultation	Functions, interests or activities not affected by project activities.	16/02/2023
CO2CRC	9	No response received	No response, continue consultation	Functions, interests or activities not affected by project activities.	9/06/2023
Coastal Planning	3	No response received	No response, continue consultation	Functions, interests or activities not affected by project activities.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Colac Otway Shire Council	15	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities of the Shire Council not affected by project activities.	9/06/2023
Commonwealth Fisheries Association	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
ConocoPhillips	8	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Cooper Energy	20	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Coorong Wild Seafood	3	No concerns raised	No concerns raised, continue consultation	Will continue to engage where EMBA is relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
Corangamite Catchment Management Authority	11	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Corangamite Shire Council	52	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
CSIRO - Coasts and Ocean Research	2	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
MP, Federal Member for Wannon	2	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
Name withheld	2	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
Deakin University - School of Life and Environmental Sciences	24	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Department for Environment and Water	2	No concerns raised	No response, continue consultation	Will continue to try and engage where our EMBA is relevant to SA coastline.	15/02/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
South Australia - Coast Protection Board				Functions, interests or activities highly unlikely to be affected, as per impact assessment.	
Department of Agriculture, Fisheries and Forestry - Biosecurity and Marine Pests	4	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Department of Climate Change, Energy, the Environment and Water - Oceans	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Department of Climate Change, Energy, the Environment and Water - Parks Australia (Marine)	9	Concerns raised	Concerns resolved, continue consultation	Beach will assess any impacts to protected species, including those with BIAs and KEFs, and will ensure appropriate control measures are in place to manage any potential impacts to AMP marine park values to an acceptable level.	9/06/2023
Department of Defence - Australian Hydrographic Office	12	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information	9/06/2023
Department of Defence - Infrastructure Division, Defence Support & Reform Group	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Energy, Environment and Climate Action: Earth Resources Regulation	19	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Environment, Land, Water and Planning - Coastcare Victoria	9	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Department of Industry, Science and Resources	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Infrastructure and Transport - Marine Safety SA	5	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Natural Resources and Environment Tasmania - Biosecurity	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Natural Resources and Environment Tasmania - Conservation	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Natural Resources and Environment Tasmania - Marine/Fisheries (Fishing Tasmania)	16	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Natural Resources and Environment Tasmania - Strategic Projects and Policy	14	No concerns raised	No concerns raised, continue consultation	Will continue to engage with the Strategic Projects and Policy Division and have agreed to provide email updates as key milestones are met and verbal briefings at the request of the Department.	31/03/2023
Department of Natural Resources and Environment Tasmania - Tasmania Parks and Wildlife Services	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Premier and Cabinet - Office of Aboriginal Affairs - (Tasmania)	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Primary Industries and Regions	6	No concerns raised	No response, continue consultation	Will continue to try and engage where our EMBA is relevant to SA coastline.	6/03/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
South Australia - Commercial Fishing				Functions, interests or activities highly unlikely to be affected, as per impact assessment.	
Department of State Growth - Mineral Resources Tasmania	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Department of Transport and Planning: Marine Pollution	4	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Dive Industry Association of Australia	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Eastern Maar Aboriginal Corporation	14	Concerns raised	Concerns resolved, continue consultation	Beach provided a detailed response answering EMACs questions raised and providing information that may be of interest. Ongoing consultation and sharing of information.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Environment Protection Authority (EPA) - South Australia	11	No concerns raised	No concerns raised, continue consultation	Will continue to engage where our EMBA is relevant to SA coastline.	8/03/2023
Environment Protection Authority (EPA) Tasmania	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Environment Protection Authority (EPA) Victoria	9	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Environment Tasmania	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Environment Victoria	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Felix Ellis MP, Tasmanian Member for North West, West Coast and King Island	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Ferguson Australia	3	No response received	No response, continue consultation	Will continue to try and engage where our EMBA is relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
First Nations Legal & Research Services Ltd	6	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
First Peoples - State Relations (Victoria)	1	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Fisheries Research and Development Corporation	9	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Fishwell Consulting	12	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Flinders Island Aboriginal Association Inc	9	No concerns raised	No concerns raised, continue consultation	Will continue to try and engage where impacts relevant to Flinders Island.	9/06/2023
Friends of Bay of Islands Coastal Park	1	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Friends of the Earth - Melbourne Chapter	7	No concerns raised	No concerns raised, continue consultation	As a National ENGO with a specific interest in gas Beach will continue to engage with the Melbourne chapter around our future Otway and Bass basin work.	4/04/2023
Frying Nemo Fish and Chips	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Gavin Pearce MP, Federal Member for Braddon	7	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Gayle Tierney MLC, Member for Western Victoria	4	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	9/06/2023
Glenelg Hopkins Catchment Management Authority	6	No response received	No response, continue consultation	Will continue to try and engage where our EMBA is relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
Glenelg Shire Council	1	No response received	No response, continue consultation	Will continue to try and engage where our EMBA is relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	16/02/2023
Go Surf School	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment. Continue to engage as per Regulation 11(A)(1)(d) and Beach's Community Engagement Standards.	9/06/2023
Grassroots Deli Cafe	3	No response received	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment. Continue to engage as per Regulation 11(A)(1)(d) and Beach's Community Engagement Standards.	9/06/2023
Great Ocean Abalone	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Great Ocean Road Coast and Parks Authority	4	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Great Ocean Road Regional Tourism	6	No response received	No response, continue consultation	Functions, interests or activities of this organisation are not affected.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Great Ocean Road Tourist Park	3	No response received	No response, continue consultation	Functions, interests or activities of this organisation are not affected	9/06/2023
Greenpeace	4	No response received	No response, continue consultation	As a national ENGO with an interest in gas Beach will continue to try to engage.	21/03/2023
Gunaikurnai Land and Waters Aboriginal Corporation	13	No response received	No response, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	9/06/2023
Gunditj Mirring Traditional Owners Aboriginal Corporation	18	No concerns raised	No concerns raised, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	9/06/2023
Indigenous Land and Sea Corporation	4	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Institute for Marine and Antarctic Studies, University of Tasmania	12	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
International Fund for Animal Welfare	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
MLC, Member for Western Victoria	1	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	15/02/2023
Name withheld	3	No response received	No response, continue consultation	Will continue to try to engage where our EMBA is relevant to Portland area.	6/03/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Kelp Industries Pty Ltd	3	Concerns raised	Concerns remain, maintain consultation	Engagement on future activities likely more relevant. This activity is highly unlikely to impact them.	6/03/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
King Island Boat Club	3	No response received	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	9/06/2023
King Island Chamber of Commerce	6	No response received	No response, continue consultation	Will continue to try to engage where impacts relevant to King Island area.	9/06/2023
King Island Council	6	No response received	No response, continue consultation	Will continue to try to engage where impacts relevant to King Island area.	9/06/2023
King Island Regional Development Organisation	3	No concerns raised	No concerns raised, continue consultation	Taken their advice on suggested local contacts. Will continue to engage where our impacts relevant to King Island area.	9/06/2023
King Island Shipping Group	3	No response received	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	9/06/2023
King Island Surf Safaris	3	No response received	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	9/06/2023
King Island Tourism/Visitor Information Centre	3	No response received	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	9/06/2023
King Island Tours	3	No response received	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Land and Sea Aboriginal Corporation Tasmania	1	No response received	No response, discontinue consultation	No longer exist	27/02/2023
Life Saving Victoria	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Lochard Energy	8	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
MacTaggart Marine	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Marine and Safety Tasmania	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Marine Mammal Foundation	3	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Moyne Shire Council	19	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Muollo Fishing	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Mures Fishing	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
National Native Title Tribunal	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
National Offshore Petroleum Safety Environment Management Authority (NOPSEMA)	3	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Nelson Coast Care Inc	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Ocean Racing Club of Victoria	9	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Ocean Road Abalone (Southern Ocean Mariculture)	4	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Office of the Member for Northern Victoria Region	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Office of the Member for Polwarth	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Office of the Member for South West Coast	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Office of the Member for Western Victoria	3	No response received	No response, continue consultation	Functions, interests or activities may be affected.	9/06/2023
Office of the Minister Energy and Resources	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Office of the Minister for Agriculture and Minister for Regional Development	3	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	7/03/2023
Office of the Minister for Environment	3	No concerns	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	23/02/2023
Office of the Minister for Resources	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Name withheld	1	No response received	No response, discontinue consultation	Discontinue consultation as cannot contact.	21/02/2023
Otway Climate Emergency Action Network (OCEAN)	15	Concerns raised	Concerns remain, maintain consultation	Post meeting correspondence with OCEAN suggests they do not see value in meeting again. Beach will continue to provide information on activities via email and is open to a meeting again should OCEAN wish to. OCEAN did not provide the details of the quoted traditional owner despite follow up requests.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Otway Gas Plant Community Reference Group	17	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Otway Water	2	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	13/12/2022
Paaratte Eel Company	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Parks Victoria	23	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Penguin Foundation	2	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	14/02/2023
Name withheld	3	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
Peterborough General Store and Takeaway Food	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Peterborough Golf Club	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Peterborough House	6	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Peterborough Licensed grocers	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Peterborough Residents Association	12	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Petuna Sealord Deepwater Fishing Pty Ltd	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Port Campbell Board Riders Association	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Boat Charters	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Port Campbell Community Group	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Hotel	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Lobster	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Port Campbell Police	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Professional Fishermans Association	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Port Campbell Progress Association	6	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Rifle Range	6	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Surf Life Saving Club	11	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Take Away	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Trading Co.	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Campbell Visitor Information Centre	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Port Central Apartments	4	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port Fairy Boardriders	1	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	16/02/2023
Port Fairy Surf Life Saving Club	4	No response received	No response, continue consultation	Will continue to engage where future EMBA may impact.	6/03/2023
Port Fairy Yacht Club	5	No concerns raised	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
Port O' Call Motel	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Port of Port Fairy	1	No response received	No response, continue consultation	Will continue to try to engage where a future EMBA may impact area.	16/02/2023
Port of Portland	7	No concerns raised	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
Portland SCUBA	3	No concerns raised	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
Portland Sport Fishing Club	3	No concerns raised	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
Portland Surf Life Saving Club	3	No response received	No response, continue consultation	Will continue trying to engage where a future EMBA may impact location.	6/03/2023
Portland Yacht Club	3	No concerns raised	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
Name withheld	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
REAL Pizza Pasta Salads	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
RHG Fisheries	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Richey Fishing Company	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Schlumberger Australia Pty Ltd	2	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
SCUBA Divers Federation of Victoria	9	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Sea Foam Villas Port Campbell	6	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Seafood Industry Australia	4	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Seafood Industry Victoria	19	No concerns raised	No concerns raised, continue consultation	Beach will continue to work with SIV to engage with members.	9/06/2023
Sharkmen Charters	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
South Australian Rock Lobster Advisory Council and South Eastern Professional Fishermen's Association	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
South East Trawl Fishing Industry Association	11	No concerns raised	No concerns raised, continue consultation	No concerns around this consultation. Beach will continue to work with the industry and commercial fishing sector to explore more efficient ways to engage.	9/06/2023
South West Regional Executive Forum	26	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Southern Fishermen's Association Inc.	2	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Southern Rock Lobster Limited	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Southern Shark Industry Alliance (SSIA)	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
State Member for Western Victoria Region	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
State Member for Western Victoria Region	2	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
Superloop	4	No concerns raised	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Surf Coast Shire Council	20	Concerns raised	Concerns remain, maintain consultation	Beach has included Council's opposition as requested.	9/06/2023
Surfcoast Anglers	1	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	14/02/2023
Surfers For Climate	3	Concerns raised	Concerns remain, maintain consultation	Opposition to project included in records for NOPSEMA.	22/02/2023
Surfrider Foundation Australia	14	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
MP State Member for Port Adelaide	5	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	24/02/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Sustainable Shark Fishing Association	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
TARFish	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
TasKelp	2	No response received	No response, continue consultation	Will continue to try and engage where any future EMBA is relevant.	15/02/2023
Tasmania Salmonid Growers Association	4	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Tasmanian Abalone Council Ltd	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Tasmanian Aboriginal Centre	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	27/02/2023
Tasmanian Rock Lobster Fisherman's Association	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Tasmanian Seafood Industry Council	6	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Tasmanian Seafoods	7	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Tasports	6	No concerns raised	No concerns raised, continue consultation	Will continue to try and engage where any future impacts relevant	6/03/2023
TGS (previously Spectrum Geo)	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Timboon Action Group	13	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Timboon Recreational Fishing Club	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Toberfish	3	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Transport Safety Victoria - Maritime Safety Victoria	10	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Trinsand Fisheries	6	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Tuna Australia	7	Concerns raised	Concerns resolved, continue consultation	Beach agrees in principle to a service charge from Tuna Australia to assess impacts from our activities where it is required. In this instance, we do not believe assessment is required based on our assessment of tuna fishing in our project area.	9/06/2023
Twelve Apostles Tourism and Business Group	9	No concerns raised	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
Victorian Fisheries Authority	12	No response received	No response, continue consultation	VFA have previously been engaged and provided fishing effort data in response to Beach's requests, to enable assessment of potential commercial fishing impacts for the Otway Offshore Project. Continue to engage as per Regulation 11(A)(1)(b).	9/06/2023
Victorian National Parks Association	9	No concerns raised	No concerns raised, continue consultation	All questions and requests were responded to and appreciated by Parks Victoria.	1/03/2023
Victorian Scallop Fishermen's Association	9	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023
VR Fish	9	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	9/06/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Wadawurrung Traditional Owners Aboriginal Corporation	6	Concerns raised	Concerns remain, maintain consultation	Concerns raised around coastal erosion and dredging. Beach explained that whilst these concerns are important they are not linked to offshore activities.	9/06/2023
Warrnambool City Council	6	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Coastcare Landcare Network	4	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Professional Fishermen's Association	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Surf Life Saving Club	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Visitor Information Centre	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Volunteer Coast Guard	6	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Warrnambool Yacht Club	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant	9/06/2023
Waves Cafe, Bar and Restaurant	3	No response received	No response, continue consultation	Functions, interests or activities not affected by activities.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Western Abalone Divers Association	6	No response received	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	9/06/2023
Wilderness Society Tasmania	5	No concerns raised	No concerns raised, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
Wilderness Society Victoria	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	21/03/2023

Organisation Name	Number of Engagements	Engagement Status	Assessment Summary	Assessment Detail	Last Engagement Date
Wye River Surf Life Saving Club	5	No response received	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
Name withheld	13	Concerns raised	Concerns remain, maintain consultation	Questions raised are not relevant to this consultation, but we will provide info requested.	9/06/2023
Name withheld	3	No response received	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	9/06/2023

5 Environmental Impact and Risk Assessment Methodology

5.1 Overview

Beach has identified, qualitatively risk assessed and reviewed the environmental hazards associated with the project. The methodology utilised is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, Risk Management – Principles and Guidelines).

All hazards have been assessed to pose only a low or medium risk to the environment with risk controls in place. All hazards have been carefully reviewed and the controls in place to prevent and mitigate them have been examined for adequacy. All hazards are considered to be currently reduced to ALARP and risk to the environment from the activity is also considered to be acceptable. ALARP is an ongoing process and this assessment of and implementation of new controls is integral to Beach's risk management process.

5.2 Communicate and Consult

In alignment with Regulation 11A(2) of the OPGGS(E)R and 16 (8) and 19 (b) of the OPGGS Regulations (Vic), during the development of this EP, Beach has consulted with relevant person(s) (stakeholders) to obtain information in relation to their activities within the Operational Area and potential impacts to their activities. This information is used to inform the EP and the risk assessment undertaken for the activity. Stakeholder consultation is an iterative process that continues throughout the development of the EP and for the duration of a petroleum activity.

5.3 Methodology

Figure 11 presents an overview of the Beach Environmental Risk Assessment process for identifying, assessing and reviewing the hazards to ensure the risk is ALARP.

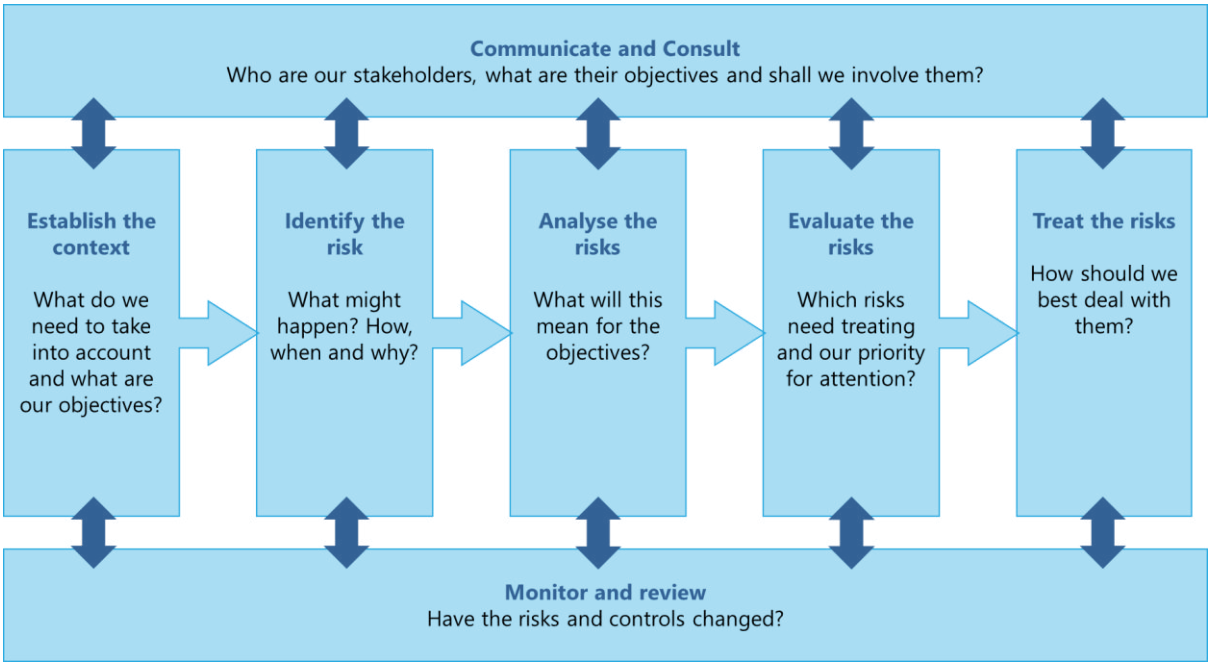

Figure 11: Risk Assessment Process

5.3.1 Identify the Potential Impacts and Risks

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

5.3.2 Analyse the Potential Impacts and Risks

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

5.3.3 Establish Environmental Performance Outcomes

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

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

5.3.4 Evaluate and Treat the Potential Impacts and Risks

The following steps are undertaken using the Beach OEMS Element 8, BSTD 8.1 Risk Management Standard, Risk Matrix (Table 12) 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) and an acceptable level.
- Establish environmental performance standards for each of the identified control measures.

Table 12: Environmental Risk Assessment Matrix

CDN 14740489 Beach Risk Matrix & Risk Management Quick Reference Guide

Risk Matrix

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

5.3.5 Demonstration of ALARP

Following the initial hazard identification and qualitative risk assessment, Beach reviewed each of the hazards and gathered data to better define them and to confirm likelihood and consequences.

The extent of the review needed to determine the acceptability of risk should be commensurate with the level of risk, the inherent consequence and how society accepts similar hazards from other users and industries. For example, if an event has virtually no environmental impact and is standard accepted practice within other industries then the demonstration of acceptability and ALARP should be relatively simple. On the other hand, if there is significant risk, with potentially major consequences and it is not a standard industry or community accepted practice then Beach has spent considerably more effort assessing it, examining the controls to ensure they are effective and determining other risk reduction measures to be implemented.

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.

5.4 Demonstration of Acceptability

The OPGGS(E)R and OPGGS Regulations (Vic) require 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.

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.

5.5 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.

6 Environmental Impact and Risk Assessment

6.1 Overview

In alignment with Regulation 13 (5) of the OPGGS(E)R and Regulations 15 (3)(c), 15 (3)(d), 15 (3)(e) and 15 (4) of the OPGGS Regulations (Vic), this section of the EP details the potential environmental impacts and risks associated with the activity and provides an evaluation of all the impacts and risks appropriate to the nature and scale of each impact or risk. This evaluation includes impacts and risks arising directly or indirectly from the activity and includes potential oil pollution emergencies and the implementation of oil spill response strategies and oil spill monitoring.

In addition, this section details the control measures (systems, procedures, personnel or equipment) that will be used to reduce potential impacts and risks to ALARP and acceptable levels. Environmental performance outcomes (EPOs), environmental performance standards (EPSs) and measurement criteria associated with each of the identified control measures are provided in Section 7.

Aspects associated with the use of vessels for oil spill response activities are as per vessel operations in Table 13. Other aspects and related impacts and risks associated with oil spill response activities are described in Section 6.19

Table 13: Activity – Aspect Relationship

ACTIVITIES / ASPECT	Light emissions	Atmospheric emissions	Underwater sound emissions	Physical presence	Benthic disturbance	Planned marine discharges- Vessels	Planned marine discharges- Operations and IMR	Establishment of IMS	Disturbance to marine fauna	Unplanned Marine Discharge (Solids)	Loss of Containment
Thylacine-A Wellhead Platform operations											
Platform operations	✓	✓	✓	✓					✓	✓	✓
Otway Pipeline System Operations											
Pipeline operations				✓							✓
Subsea Facilities Operations											
Subsea infrastructure operations				✓			✓				✓
Subsea production wells			✓	✓			✓				✓
Inspection, maintenance, and repair											
Inspection, maintenance, and repair campaigns			✓	✓	✓		✓				✓
Support Operations											
Diving and RoV Operations				✓	✓						
Vessel operations	✓	✓	✓	✓		✓		✓	✓	✓	✓
Helicopter operations		✓	✓								

6.2 Light Emissions

6.2.1 Hazards

The Thylacine-A Wellhead Platform is normally unmanned, with lighting limited to that required for navigation which includes platform lighting remaining on when platform unmanned as per the Thylacine-A Platform Safety Case. The platform is not equipped with a flare.

During IMR and geophysical surveys, vessel activities may be undertaken 24 hours a day. Therefore, lighting is required at night for navigation and to ensure safe operations when working on vessels.

Light emissions from Thylacine-A Wellhead Platform and vessels will result in a change in ambient light.

6.2.2 Predicted Environmental Impacts

The predicted environmental impacts from light emissions are:

- Changes in ambient light leading to changes in fauna behaviour, through attraction or avoidance of light-sensitive species.

6.2.3 EMBA

The EMBA for light emissions is based on the National Light Pollution Guidelines for Wildlife (the Guidelines) (CoA 2023). The guidelines recommend undertaking a light impact assessment where important habitat for list species sensitive to light are located within 20 km of the light source. The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km and fledgling seabirds grounded in response to artificial light 15 km away (CoA 2023). Seabird grounding, as described in Rodriguez et al (2014), relates to impacts of onshore fixed light sources such as streetlights and buildings and the effect this can have on young fledgling birds making their first flight from their nests to the open ocean. Subsequently, the 20 km light EMBA adopted here is considered to be highly conservative.

The guidelines identify marine turtles, seabirds and migratory shorebirds as potentially being impacted by artificial light to a level significant enough to require assessment. Other species such as zooplankton, invertebrates and fish are also discussed (CoA 2023).

The guidelines detail that important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal. For this assessment a distance of 20 km from the operational area was used to identify any areas where turtles, shorebirds and seabirds may be foraging, breeding, roosting, or migrating. This area (20 km around the operational area) is called the light EMBA.

Table 14 details the shorebirds and seabirds that may be foraging, breeding, roosting or migrating within the light EMBA. These were identified from the light EMBA PMST Report (Appendix A.3) and BIAs from the National Conservation Values Atlas. No roosting or breeding behaviours have been identified within the light EMBA.

Artificial light can disrupt turtle nesting and hatching behaviours. Artificial light is listed as a key threat in the Recovery Plan for Marine Turtles in Australia (CoA 2017b). Listed turtle species may occur within the light EMBA, however, no biologically important behaviours, BIAs, or habitat critical to survival for

marine turtles were identified. In addition, there are no turtle nesting areas in the region. Therefore, impacts to turtles from light emissions is not predicted.

The HDD entry point is located approximately 500 m from the shoreline, therefore vessels operating at the HDD entry point location will be visible from the coast. The nearest homes are located at Port Campbell; approximately 2.2 km from the HDD entry point. Whilst vessels operating at the HDD entry point will be visible from the shoreline, activities will be short-term inspection, maintenance, or repair activities with light levels equivalent to other vessel traffic in the area, and therefore impacts on coastal settlements are not considered further.

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

- Seabirds and migratory shorebirds.
- Zooplankton, invertebrates, and fish

Table 14: Light Sensitive Receptors within the light EMBA with BIAs or undertaking Biologically Important Behaviour

Receptor	Biologically Important Behaviour
Albatross	
Antipodean albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Black-browed albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Buller's albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Campbell albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Indian yellow-nosed albatross	Foraging BIA
Northern Buller's albatross	Foraging, feeding or related behaviour likely to occur within area
Northern royal albatross	Foraging, feeding or related behaviour likely to occur within area
Salvin's albatross	Foraging, feeding or related behaviour likely to occur within area
Shy albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Southern royal albatross	Foraging, feeding or related behaviour likely to occur within area
Wandering albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
White-capped albatross	Foraging, feeding or related behaviour likely to occur within area
Other	
Common diving-petrel	Foraging BIA
Flesh-footed shearwater	Foraging, feeding or related behaviour likely to occur within area

Receptor	Biologically Important Behaviour
Little curlew	Roosting likely to occur within area
Orange-bellied parrot	Migrating likely
Northern giant petrel	Foraging, feeding or related behaviour likely to occur within area
Pin-tailed snipe	Roosting likely to occur within area
Swinhoe's snipe	Roosting likely to occur within area
Short-tailed shearwater	Foraging BIA
Wedge-tailed shearwater	Foraging BIA Breeding BIA

6.2.4 Consequence Evaluation

For the light impact assessment, the process outlined in the guidelines is used. The aim of the guidelines is that artificial light will be managed so wildlife is:

1. Not disrupted within, nor displaced from, important habitat.

2. Able to undertake critical behaviours such as foraging, reproduction and dispersal.

Identification of light-sensitive receptors was undertaken through definition of a 20 km light EMBA. The actual predicted area of impact at any one time will be significantly less than 20 km around each vessel operating within the operational area.

Vessel activities will occur up to 500 m from the shoreline (at the HDD entry point), therefore impacts to seabird and migratory shorebird coastal habitats (such as roosting sites) could occur, with the PMST Report identifying the little curlew, pin-tailed swipe and Swinhoe's snipe likely to roost within the area of the light EMBA. These species are migratory wetland species and are covered by the Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE 2015d) which does not identify light as a threat.

The light EMBA PMST Report identified likely foraging behaviour for a number of albatrosses in the light EMBA. Some of these species have foraging BIAs that the light EMBA overlaps (Table 14). Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022a) however, no actions are identified. Albatrosses forage most actively during daylight and are less active at night because their ability to see and capture prey from the air is reduced (Phalan et al. 2007). Thus, impacts within the small area of overlap with albatross foraging BIAs are not predicted based on these species forage most actively during daylight.

The common diving-petrel was not identified in the light EMBA PMST Report. This species is listed as marine and does not have a recovery plan or conservation advice. The light EMBA overlaps a foraging BIA within the SEMR. Brooke (2004) cited on Animal Diversity Web (2020) details that common diving petrels spend the night in burrows during the breeding season and seem to forage mainly during the day, although they also forage at night on vertically migrating plankton. They are thought to be fairly sedentary, remaining more or less in the area of their breeding colony year-round, although they may venture into the open ocean to forage outside of the breeding season and some studies suggest seasonal movements (Brooke, 2004 cited on Animal Diversity Web, 2020). Based on this information, common diving-petrels may forage at night within the light EMBA.

The northern giant petrel was identified in the light EMBA PMST Report as foraging likely within the light EMBA. It is thought to be a predominantly diurnal forager, but it feeds its chicks during both the day and at night (DoE 2023ab). Breeding occurs on Macquarie Island between New Zealand and Antarctica. Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022a) however, no actions are identified.

The light EMBA PMST Report (Appendix A.3) identified migration route likely for the orange-bellied parrot. No BIA or habitat critical to the survival of the species where identified. The orange-bellied parrot is a ground feeding parrot which breeds in south-west Tasmania between November and March and then overwinters on the coast of south-east mainland Australia between April and October (DELWP 2016). The orange-bellied parrot is classed as critically endangered and there are about 50 remaining in the wild (DELWP 2016). The orange-bellied parrot recovery plan identifies illuminated structures and illuminated boats as a potential barrier to migration and movement (DELWP 2016). IMR activities may overlap the period when orange-bellied parrots migrate between Tasmania and Victoria between late February to early April (Australian Museum 2020). The light EMBA overlaps the likely distribution and probably migration route for the orange-bellied parrot.

The flesh-footed shearwater was identified in the light EMBA PMST Report as foraging likely within the light EMBA. The flesh-footed shearwater routinely attends fishing vessels to feed on baited hooks, discarded scraps and prey attracted to the surface by such vessels (DoE 2023f), thus they may be attracted to light water surface area to forage.

The short-tailed shearwater was identified in the light EMBA PMST Report as foraging likely within the light EMBA. The light EMBA overlaps a foraging BIA within the SEMR. 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. The light EMBA overlaps a foraging BIA and breeding BIA. The foraging and breeding BIAs intersected by the light EMBA are a buffer around Muttonbird Island, Victoria. 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 (DoE 2023g). A review of the DCCEEW 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 DCCEEW SPRAT profile does not show any locations for the wedge-tailed shearwater in Victoria and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of wedge-tail shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border. However, impacts to this species from light emissions are not predicted as Warham, (1996) cited in Beaver (2018) details that the wedge-tailed shearwater forms large aggregations referred to as “rafts” just offshore from their breeding colony just on dusk and enter and leave the colony at night to avoid predators.

Normal working lights on marine research vessels—and, by implication, lights from other sources including fishing boats, cargo vessels, recreational watercraft, jetties and oil and gas platforms—have been shown to cause zooplankton and their vertebrate predators to descend away from the surface; these effects occurred at depths of up to 200 m, and up to 200 m horizontally from the light source

(Berge et al., 2020 in CoA 2023). Since most zooplankton need to ascend to forage on phytoplankton near the water's surface, light pollution may lead to an overall reduction in zooplankton, with cascading effects on their predators, and so on up the food chain (CoA 2023).

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

The extent of the area of potential impact is predicted to be up to 20 km from the operational area with a maximum duration of 30 days for an IMR activity.

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

- For IMR activities light will be generated by a single vessel for up to 30 days and for geophysical surveys for up to 10 days. Light may also be generated by a single vessel when providing standby support to the Thylacine-A Wellhead Platform for platform campaigns that take longer than a day. For these campaigns, personnel return to and from the platform each day but the vessel stays in the area of the platform rather than return to and from shore. In these cases, vessel lighting would be the minimum required for navigational lighting as no work is being undertaken at night.
- Lighting on the Thylacine-A Wellhead Platform is limited to that required safe operating requirement in accordance with the accepted Thylacine-A Platform Safety Case. Lights on the platform have been replaced with lower impact LED lighting.
- Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022) however, no actions are identified.
- Of the seabirds that may potentially forage within the light EMBA the common diving-petrel, northern giant petrel and short-tailed shearwater were identified as potentially foraging at night.
- The orange-bellied parrot, which is classed as critically endangered, may migrate over the light EMBA during April to June. Illuminated structures and illuminated boats have been identified as a potential barrier to migration and movement for this species (DELWP 2016).
- No BIAs or spawning areas are identified within the light EMBA for fish or invertebrates.

6.2.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Light emissions	
ALARP decision context and justification	ALARP Decision Context: Type A

	Impacts from light emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
CM#1: Light Management Procedure	The National Light Pollution Guidelines for Wildlife (CoA 2023) provide management options for mitigating the effect of light to fauna. A review of the management options relevant to the activity is provided in the additional controls section with the following to be adopted: Vessels will have and implement a Light Management Procedure as per the National Light Pollution Guidelines for Wildlife (CoA 2023). The Light Management Procedure will detail mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox and Beach Energy's Vessel Light Management Procedure Guidance (CDN/ID 19012450). At a minimum the Vessel Light Management Procedure will cover: screens, blinds or window tinting on windows to contain light inside the vessels. outdoor/deck lights when not necessary for human safety or navigation will be turned off. lights will be directed onto work areas. program for handling grounded birds. reporting requirements.
CM#2: Marking of Man-Made Offshore Structures	Platform navigation lighting complies with sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).

Additional controls assessed

Control	Cost/Benefit Analysis	Control Implemented?
Seasonal timing	Operations are required to occur year round, therefore activities may be undertaken at any time throughout the year. The following seasonal timings were identified for the species that may be active at night within the light EMBA: Orange-bellied parrot: late February to early April (Australian Museum 2020). Common diving petrel: year round (DCCEEW 2023b). Northern giant petrel; May to October (DoE 2023ab) Short-tailed shearwater: September to April (AAD 2020) Controls have been identified to ensure lighting is reduced to that for safe operations considering that vessels may be required to resupply the platform and undertake IMR activities. In 15 years of operating the Thylacine-A Wellhead Platform no orange-bellied parrots have been recorded. Avoiding the orange-bellied parrot migration is not commensurate to the level of impacts predicted. Other species are present all year round or for large portion of the year or do not forage at night thus restricting the period when activities will occur does not afford any benefit to these species.	No

Implement management actions during the breeding season. Light management should be implemented during the nesting and fledgling periods.	The light EMBA is at the closest distance ~12 km from islands or a coast where nesting and fledglings may be located. As no impact to nesting or fledglings is predicted the control does not have an environmental benefit.	No
Maintain a dark zone between the rookery and the light sources	The light EMBA is at the closest distance ~12 km from islands or a coast where rookeries may occur, therefore a dark zone between the and potential rookeries and the light sources will be maintained.	Yes
Turn off lights during fledgling season. Use curfews to manage lighting such as extinguish lights around the rookery during the fledgling period by 7 pm as fledglings leave their nest early in the evening.	The light EMBA is 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.	The light EMBA is at the closest distance ~12 km from islands or a coast where nesting may occur. As no impact to nesting areas is predicted the control does not have an environmental benefit.	No
CM#1: Light Management Procedure Prevent indoor lighting reaching outdoor environment.	Use of fixed window screens, blinds or window tinting on vessel windows to contain light inside has the environmental benefit of reducing light emissions from the activity.	Yes
CM#1: Light Management Procedure Reduce unnecessary outdoor, deck lighting on all vessels and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Extinguishing vessel outdoor/deck lights when not necessary for human safety and restrict lighting at night to navigation lights has the environmental benefit of reducing light emissions from activity. Thylacine-A Platform Safety Case requires platform lighting to remain on when platform unmanned as a navigation requirement.	Yes
CM#1: Light Management Procedure Vessels working in seabird foraging areas during breeding season should implement a seabird management plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.	As the vessel activities may occur year round, a vessel Light Management Procedure will be developed and implemented as per the National Light Pollution Guidelines for Wildlife (CoA 2023). CoA will detail mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox.	Yes
CM#1: Light Management Procedure	Mitigations to manage light, including appropriate use and types of lights, will be reviewed as part of the Light Management Procedure (detailed above). Where the Light Management	Yes – where appropriate

Use flashing/intermittent lights instead of fixed beam. Use motion sensors to turn lights on only when needed. Avoid lights containing short wavelength violet/blue light. Avoid white LEDs. Avoid high intensity light of any colour.	Procedure identifies changes to vessel lighting that has a cost/benefit these mitigations will be implemented.	
CM#1: Light Management Procedure Design and implement a rescue program for grounded birds.	A rescue program will not prevent birds grounding, but as it has proven useful to reducing mortality of seabirds it has an environmental benefit. The program will be developed as part of the Light Management Procedure (CM#1) and will include advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover: handling of birds. releasing of birds reporting to DCCEEW in the case of protected species. Note: a recovery program can only occur on the Thylacine-A Platform when it is manned.	Yes – where appropriate
Consequence rating	Moderate (2) with no controls but this would be reduced to Minor (1) with identified controls implemented.	
Likelihood of occurrence	NA	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	Light emissions were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.	
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 8)	
External context	There have been no stakeholder objections or claims regarding light emissions. The project area has significant vessel activity. These vessels typically do not have controls on light emissions and are unlikely to comply with the National Light Pollution Guidelines. These vessels will contribute significantly to light pollution in the area.	
Other requirements	Thylacine-A Platform Safety Case requires platform lighting to remain on when platform unmanned as a navigation requirement. Light emissions will be managed in accordance with the National Light Pollution Guidelines for Wildlife (CoA 2023). Light pollution is identified as a threat in the Wildlife Conservation Plan for Seabirds (CoA 2020b) and details that the National Light Pollution Guidelines for	

	Wildlife (CoA 2023). CoA provide a framework for assessing and managing these impacts around susceptible listed wildlife. Light emissions will be managed in accordance with the National Light Pollution Guidelines for Wildlife (CoA 2023). Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022a) however, no actions are identified. The implementation of vessel Light Management Plans will ensure that lighting is of a level that will not impact on the recovery of threatened albatrosses or petrels. There are no recovery plans, conservation advice or listing advice for the common diving-petrel, flesh-footed shearwater, little curlew, northern giant petrel, pin-tailed snipe, short-tailed, Swinhoe's snipe, shearwater or wedge-tailed shearwater that have BIAs or are undertaking biologically important behaviour within the light EMBA. Light emissions will be managed in a manner to not impact on the recovery orange-bellied parrot as per the orange-bellied parrot recovery plan (DELWP 2016).
Monitoring and reporting	Impacts associated with light emissions are for a short duration (i.e. during an IMR campaign), over a small area and not predicted to have long term impacts to fauna in the area. Therefore, the monitoring of light emissions is not proposed. Reporting of injury to or death of EPBC Act-listed species will be undertaken as detailed in the EP.
Acceptability outcome	**Acceptable**

6.3 Atmospheric Emissions

6.3.1 Hazards

Atmospheric emissions are generally considered to be any emission or entrainment process from a point, non-point or mobile sources that results in air pollution. This includes pollutants associated with greenhouse gas (GHG) emissions). With regards to Otway Operations these emission sources include:

- Combustion engines used on the Thylacine-A Wellhead Platform.
- Vessels used to resupply the offshore platform, helicopters used to transfer personnel and equipment to the platform and vessels used for IMR campaigns.
- Thylacine-A Wellhead Platform continuous vent purge.
- Fugitive emissions.

As per the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (2004), GHG emissions are categorised as:

- Scope 1: GHG emissions that a company makes directly.
- Scope 2: GHG emissions a company makes indirectly such as through the purchase of electricity.
- Scope 3: GHG emissions associated, not with the company itself, but that the organisation is indirectly responsible for, up and down its value chain. For example, from buying products from its suppliers and the emissions associated with making the products, and from its own products when customers use them.

For the scope of this EP the following applies:

- Scope 1: GHG emissions associated with the Otway Offshore Operations i.e., Thylacine-A Wellhead Platform.
- Scope 2: are not relevant for the Otway Offshore Operations as no electricity is purchased.
- Scope 3: GHG emissions associated with supporting services such as vessels and helicopters, and the production, transport and use of Otway Offshore Operations hydrocarbon products.

The Thylacine-A Wellhead Platform generators typically use gas, although diesel can be used during non-routine activities. Vessels will be powered by diesel (marine diesel oil (MDO)).

Atmospheric emissions will also be generated by the vent system. The Thylacine-A Wellhead Platform has a continuous vent purge (approximately 0.003 MMscfd) of fuel gas to prevent air ingress to the vent and drain system. Some venting of non-combusted hydrocarbon gas also occurs during routine maintenance and intermittently during wireline activities. This is usually in the order of 100 standard cubic metres per routine.

The Thylacine-A Wellhead Platform is equipped with a relief and blowdown system which vents to the vents and drain system. This system will assist in preventing over pressurisation of the process system due to process upset conditions or jet fire impingement. A period of venting may also be required for warming up the wells prior to repressurising the production pipeline, following certain maintenance activities. The volume of gas to be vented may be between 21 tonnes (2 hours warm-up) and 52 tonnes (5 hours warm-up).

Atmospheric venting was selected over flaring because of its inherent simplicity and reliability, which is essential for an unmanned operations. There is no flare on the Thylacine-A Wellhead Platform.

6.3.1.1 Estimated Emissions Inventory

Emissions Modelling

A detailed GHG emissions study has been completed for the offshore fields to estimate full field life GHG emissions including Scope 3 emissions. This study was undertaken by Xodus Group with the findings summarised in this section. Within the Scope 3 emissions estimate, indirect emissions of fuel use from helicopter, vessel platform resupply and IMR vessel servicing the facilities have also been estimated.

Indirect emissions from fuel use from conducting these activities were calculated based on 2021 data using the published NGER emissions factors and resulted in estimates of 16.7, 485 and 347 tCO2e respectively. Assumptions for fuel use were as follows:

- Helicopter: 12 round trips a year from Warrnambool to the Thylacine-A Wellhead Platform.
- Platform resupply: 4 round trips per year from Portland to Thylacine-A Wellhead Platform.
- IMR: one campaign per year with vessel from Portland spending 30 days in the field with a combination of moving to do inspection and stationary on DP to do maintenance work. This scenario is the estimated longest campaign so will overestimate typical IMR campaigns.

This direct and indirect data was used by the Xodus study to predict Otway Offshore GHG emissions either from the facilities themselves (Scope 1) or in servicing the facility (selected Scope 3 emission sources), over the life of the EP and the life of the activity. This study projects GHG emissions of approximately 31,260 tCO_2e over the remaining Geographe and Thylacine field life of approximately 15 years. Quantities and timeframe are indicative and may change over time due to well selection, well productivity and onshore production. Beach maintains its own internal forecast of Scope 1 emissions, Scope 2 emissions and selected Scope 3 emissions for its operating assets. The internal forecast is updated periodically at a frequency defined within the company's GHG Management Plan to reflect changes in production profiles, sales projections and planned abatement projects.

Direct and indirect GHG emissions peak in 2023 when the Thylacine subsea wells are bought onto production and then emissions decrease over the remaining years of production from these fields.

Other products of hydrocarbon combustion emitted to the atmosphere based on National Pollution Inventory data from Thylacine-A Wellhead Platform for 2020-21 were:

- Total Volatile Organic Compounds – 5,650 kg
- BTEX – 38.93 kg

Scope 1 GHG Emissions

Scope 1 GHG emissions associated with the Otway Offshore Operations are reported to the Clean Energy Regulator as part of the statutory annual *National Greenhouse and Energy Reporting Act* 2007 (NGER Act). NGER reporting includes direct emissions from fuel use, venting and fugitive emissions associated with the Thylacine and Geographe facilities. NGER reporting does not include indirect emissions associated with helicopters transfers to the Thylacine-A Wellhead Platform and vessels used for resupply or IMR activities.

Internal emissions forecasts show Scope 1 emissions to be steady at around 3,100 tonnes per annum until end of field life, comprised of:

- Cold vent purge (295 tpa);
- On board fuel gas combustion (368 tpa); and
- Fugitive emissions (2,500 tpa).

NGER reporting from financial year 2022 (FY22) detailed that the direct emissions from the Thylacine and Geographe facilities were 3,325 and 54 tCO2e respectively. An increase in reported Scope 1 emissions of approximately 1,500 tonnes from the combined facilities occurred from FY21 to FY22 due to the change in the calculation technique for fugitive emissions that came into effect on July 1, 2021. The change in calculation required Beach to estimate emissions during FY22 using the highly conservative Method 1 methodology as set down in the Commonwealth's NGER (Measurement) Determination.

In August 2022, Beach has publicly released a revised interim target to reduce Scope 1 and Scope 2 GHG emissions intensity (https://www.beachenergy.com.au/reducing-emissions/) on an equity basis. This new target replaces the former *25x25* initiative which set a target of a 25% reduction in Scope 1

and Scope 2 emissions on an absolute basis from its operated facilities. The change in corporate target resulted in no increase in forecast fuel and vented emissions from the Otway Offshore Facilities (unchanged at 663 tpa), as those emissions, as outlined above, are unchanging until end of field life; fugitive emissions increased from the original forecasts that underpinned the *25x25* programme to reflect the regulatory change that occurred on July 1, 2022, years after *25x25* was launched. The change in corporate target has therefore had no adverse impact on environmental impact due to operation of the offshore facilities.

(Refer to later in this topic for a detailed explanation of this regulatory change, Beach's mitigative action and the overall assessment of this regulatory change.)

In addition, Beach has an aspiration to achieve net zero Scope 1 and Scope 2 GHG emissions by 2050

Scope 3 GHG Emissions

Scope 3 or indirect GHG emissions are a result of the product from the activity being combusted or used elsewhere. Scope 3 GHG emissions can be considered indirect consequences of the activity and therefore have impacts (EPBC Act 1999 in Section 527E).

Scope 3 GHG emissions are generated by the production, transport and use of the hydrocarbon products from the Otway Offshore Operations. Scope 3 GHG emissions are not reported under the NGER Scheme but have been estimated using Australia's National Greenhouse Accounts.

The calculations utilised methods defined in the National Greenhouse and Energy Reporting (Measurement) Determination 2008. Assumptions and inclusions for Otway Offshore Scope 3 GHG emissions calculations are:

- Otway Gas Plant Scope 1 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids from the Geographe and Thylacine fields:
    - Fuel (gas and diesel engines and heaters)
    - Flare and vent emissions
    - Fugitive emissions
- Otway Gas Plant Scope 2 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids:
    - Electricity supplied by the Victorian electricity grid
- Otway Gas Plant Scope 3 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids:
    - Otway Offshore Operations product transport and use

Assumptions:

- Proportion of Otway Gas Plant emissions allocated to Otway Offshore Operations based on Otway Offshore Operations proportion of energy content of total feed gas to the facility.

- 100% of gas transmission pipeline fugitive leaks allocated to Otway Offshore Operations delivered gas (conservative assumption with relatively immaterial emissions.
- Final Otway Offshore Operations gas customer location: 40% used in Sydney, 40% used in Melbourne and 20% used in Adelaide.
- Gas use assumes large industrial users e.g., a gas fired power station.
- Gas delivery is via transmission line to city gate (no further intracity gas distribution included).

Reported GHG emissions data for 2020/21 for these facilities were utilised to determine a GHG intensity per unit of production and were coupled with 50th percentile production forecasts to determine an estimate and trajectory of future GHG emissions. This represents the most likely outcome in terms of production and emissions. Given the nature of reservoir uncertainty over total recoverable volume of hydrocarbon, higher or lower total emissions may be realised.

The Xodus study predicts Scope 3 GHG emissions in FY 2020/21 were approximately 3 $MTCO_2e$. This is predicted to increase to 5 $MTCO_2e$ in 2023, before plateauing at 2 $MTCO_2e$ until 2033 and end of production in approximately 2036 (Figure 12).

Scope 3 GHG emissions comprise 99.9% of emissions occurring associated with the Otway Offshore Operations, the remaining 0.1% is from the facilities' Scope 1 GHG emissions. Of the Scope 3 GHG emissions, over 96% result from the final use of the hydrocarbon product for power generation by the end customer. 90% of these emissions are from gas use, 3% are from both condensate use and 3% are from LPG use (Figure 12).

Future decisions regarding the selection of production from offshore and near shore wells to supply the onshore gas plant may alter the projected trajectory of emissions that are presented in this EP. Therefore this data is to be taken as indicative, and the timelines over which these GHGs will be emitted may change over the duration of this EP and life of the Thylacine and Geographe facilities.

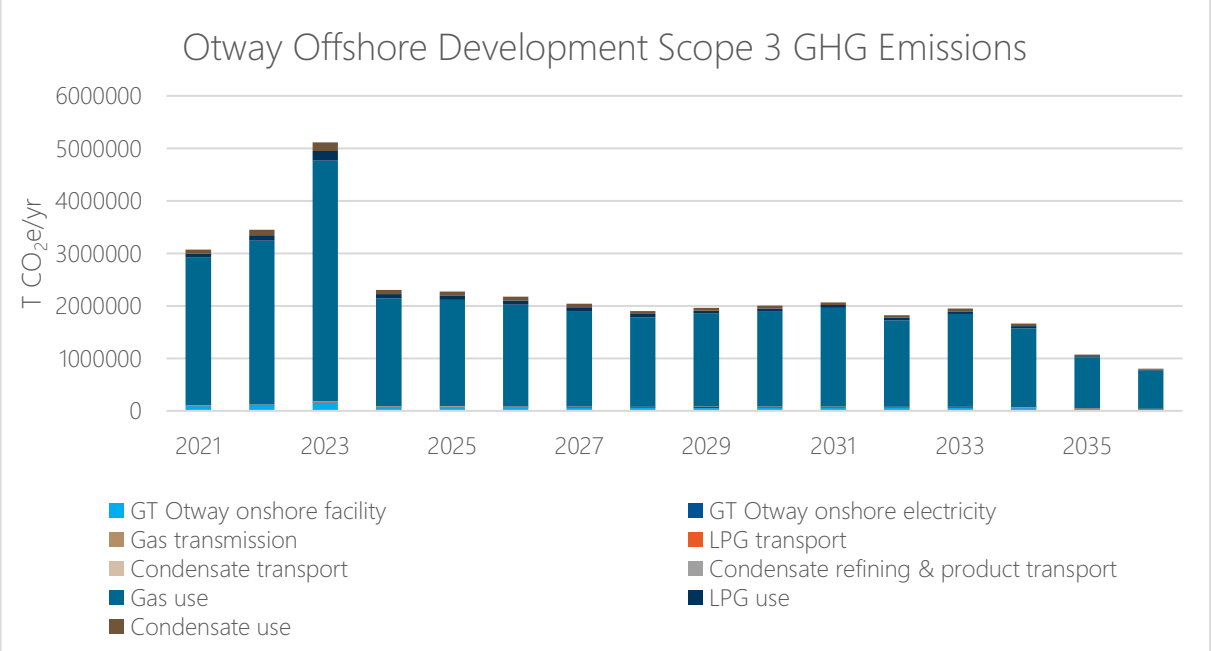

Figure 12: Otway Offshore Operations Scope 3 GHG Emission Estimate 2021 – 2036

Emissions Monitoring

As documented within Control Measure #10 (refer to Section 6.3.6), Beach will complete annual comparisons of actual Scope 1 and Scope 3 emissions from the Otway Offshore Facilities against the latest forecast. The mechanism for this annual comparison is as follows:

- The annual comparison of actual versus forecast will use the offshore facilities' annual NGER submission to the Clean Energy Regulator as the basis for comparison of the actual emissions against Beach's internal forecast;
- Material variations of the sub-categories of Scope 1 emissions and overall Scope 3 emissions against forecast will be identified and if those variations require changed assumptions or methodology for accuracy of projections, those changes will be incorporated into the next revision for the asset's greenhouse gas emissions forecast;
- Changed assumptions and/or methodology will be documented within the forecast model as a revision history page;
- As the NGER submission occurs in October of each year, the comparison exercise will therefore occur before the end of the calendar year;
- The comparison and assessment will therefore address the previous financial year's emissions and be a key input into the upcoming emissions reforecast, at the frequency set down within the company's GHG Management Plan.

Since the last EP submission, comparison of actual Scope 1 emissions against forecast showed that FY22 emissions deviated materially from those forecast due to the change in methodology for calculating fugitive emissions that occurred on July 1, 2022. The implementation of a leak detection and repair (LDAR) program that is compliant to NGER (Measurement) Determination Division 3.73H, the Method 3 technique, has been identified as a reasonably practicable measure to implement to reduce these fugitive emissions and has been incorporated into this EP as Control Measure #9.

The latest Beach emissions forecast incorporates both the new NGER methodology and the compliant offshore LDAR program as an abatement exercise, with the net effect being the fugitive emissions from the offshore facilities return to the levels originally forecast. The increase in reported fugitive emissions is viewed a transient situation and there is no on-going change to predicted environmental impacts.

6.3.2 Predicted Environmental Impacts

The predicted environmental impacts from atmospheric emissions are:

- Atmospheric emissions leading to a change in air quality and an increase in greenhouse gas emission.

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

- Air quality
- Coastal settlements
- Seabirds

GHG emissions generated during the Otway Offshore Operations and from Scope 3 GHG emissions can contribute to the overall concentration of GHG emissions in the Earth's atmosphere.

6.3.3 Consequence Evaluation

Air Quality

As the operational area is away from coastal settlements and given the limited extent of reduced air quality, adverse impact on local or regional biodiversity, ecological integrity, social amenity, or human health is not predicted.

The operational area overlaps foraging BIAs for several albatrosses, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. No habitat critical to the survival of birds occur within the operational area. As it is unlikely that seabirds would remain close to the emission source for an extended period impacts are not predicted.

Natural gas and diesel combustion, along with venting, will result in gaseous emissions of GHG such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). While these emissions add to the atmospheric GHG load, which adds to global warming potential, they are relatively small on a global scale, representing an insignificant contribution to overall GHG emissions. These emissions are not considered to have a determinable local-scale impact and therefore impacts are considered to be low.

The extent of the area of potential impact is predicted to be close to the emission source for the duration of the emission (continuously for venting on the Thylacine-A Wellhead Platform and during vessel activities) with a consequence level of Minor (1) based on:

- The low level of emissions.
- The open ocean environment and prevailing winds of the Otway Basin atmospheric emissions will rapidly disperse to background levels close to the emission source.
- Impacts to seabirds and coastal communities are not predicted.

Greenhouse Gas Emissions

GHG emissions generated during the Otway Offshore Operations can contribute to the overall concentration of GHG emissions in the Earth's atmosphere. This consequence evaluation considers the contribution of emissions attributed to the Otway Offshore Operations to global emissions and the potential impacts of climate change on sensitive receptors, including MNES within Australian jurisdictions.

It is important to acknowledge that climate change impacts cannot be directly attributed to any one activity, as they are the result of global GHG emissions, minus global GHG sinks, that have accumulated in the atmosphere since the industrial revolution began. Therefore, there is no direct link

between GHG emissions from the Otway Offshore Operations and climate change impacts to specific ecological receptors.

Changes to production capacity, reservoir composition or process design are managed under Beach's Management of Change and Project Management Systems (depending on the complexity), both of which require an assessment of the change in safety, environment and financial risk profile brought about by the proposed change, and if material, each require revisions to the relevant EP, Safety Case and/or WOMP as a necessary step to achieve completion.

Climate Systems

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) Working Group I was released in August 2021. The IPCC states with high confidence that many extreme heat events and global surface temperature rise would not have occurred without human influence and could be irreversible for several decades to millennia (IPCC 2021).

This is reiterated in the AR6 Synthesis Report released in March 2023, "[H]uman activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase over 2010-2019, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and between individuals (high confidence). Human-caused climate change is already affecting many weather and climate extremes in every region across the globe" (IPCC 2023).

According the AR6 Synthesis Report, heat extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s while cold extremes have become less frequent and less severe. Marine heatwaves have approximately doubled in frequency since the 1980s. The frequency and intensity of heavy precipitation events have increased since the 1950s over most land areas for which observational data are sufficient for trend analysis. It is likely that the global proportion of major (Category 3–5) tropical cyclone occurrence has increased over the last four decades (IPCC 2023).

Ecosystems

Ecosystems that are particularly susceptible to adverse effects of climate change include alpine habitats, coral reefs, wetlands and coastal ecosystems, polar communities, tropical forests, temperate forests and arid and semi-arid environments (DoEE 2019). In Australia, this includes coral reefs, alpine regions, rainforests, arid and semi-arid environments, mangroves, grasslands, temperate forests and sclerophyll forests. Future climate change (increased temperature and decreased, but more variable, rainfall) has the potential to have a range of impacts on ecological factors and threaten biodiversity in the Australian Mediterranean ecosystem (CSIRO 2017a).

Redistribution and reorganisation of natural systems, driven by climate-change, is a major threat to biodiversity (Chapman et al. 2020). A report by Australia's Biodiversity and Climate Change Advisory Group summarises the potential impacts of climate change to marine and terrestrial species, habitats, and ecosystems across Australia (Steffen et al. 2009). The impacts to taxa are outlined in Table 15 and the impacts to ecosystems in Table 16.

Extensive modelling and monitoring studies over the last twenty years provide considerable evidence that global climate change is already affecting and will continue to affect species (Hoegh-Guldberg et al. 2018) however, these impacts are likely to be highly species-dependent and spatially variable. The most frequently observed and cited ecological responses to climate-change include species distributions shifting towards the poles, upwards in elevation and shifts in phenology (earlier and later autumn life history events) (Dunlop et al. 2012). Climate change may not only change species distribution patterns but also life-history traits such as migration patterns, reproductive seasonality, and sex-ratios (Table 15).

Impacts of climate change such as altering temperature, rainfall patterns and fire regimes, are likely to lead to changes in vegetation structure across terrestrial ecosystems within Australia (Table 16, Dunlop et al. 2012). Increases in fire regimes will impact Australian ecosystems altering composition structure, habitat heterogeneity and ecosystem processes. Changes in climate variability, as well as averages, could also be important drivers of altered species interactions, both native and invasive species (Dunlop et al. 2012). Climate change could result in significant ecosystem shifts, as well as alterations to species ranges and abundances within those ecosystems (Hoegh-Guldberg et al. 2018).

The IPCC Special Report describes impacts of warming above pre-industrial levels to key receptor groups including terrestrial ecosystems, mangroves, warm-water corals, unique and threatened systems, and arctic regions (Hoegh-Guldberg et. al. 2018). These receptor groups show varying sensitivity to warming conditions, with a range of responses shown at 1°C warming; from corals suffering moderate impacts, to mangroves not showing any impacts that are detectable and attributable to climate change (Hoegh-Guldberg et al. 2018). Once warming reaches 1.5°C, all receptor groups show impacts attributable to climate change with severity ranging from moderate impacts that are detectable and attributable to climate change (mangroves), to impacts that are severe and widespread (warm-water corals) (Hoegh-Guldberg et al. 2018). At the point where global temperature rise, due to climate change, reaches 2°C, increasing numbers of receptor groups suffer impacts which are high to very high, and likely to be irreversible (terrestrial ecosystems, warm-water corals, unique and threatened systems, and arctic regions) (Hoegh-Guldberg et al. 2018).

The State of the Environment (SoE) report is produced every five years by the Australian Government as a comprehensive review on the state of the Australian environment. The most recent report was released in July 2022. The SoE concluded that climate change and extreme weather events was impacting the Australian environment and especially impacting various taxa (DCCEEW 2021). In many cases, the impacts of climate change on biodiversity are exacerbated by other pressures such as land clearing and invasive species, but in some cases impacts can be unequivocally attributed to climate change. A summary of the SoE impacts from climate change is provided in Table 17.

Terrestrial Ecosystems

All terrestrial ecosystems are likely to be impacted by a changing climate (Table 16, Steffen et al 2009, Hughes 2011, Dunlop et al. 2012, Hoegh-Guldberg et. al. 2018). The predicted impact of climate change on these ecosystems is highly variable, both between ecosystems and within individual ecosystems (Dunlop et al. 2012). Below is a summary of potential climate change impacts to two key terrestrial ecosystems – tropical rainforests and alpine/montane areas, other terrestrial ecosystems are summarised in Table 16.

Tropical Rainforests

Projections of future climate changes in the wet tropics of Australia under different scenarios are outlined by McInnes (2015). It is likely that temperatures in the wet tropics will become hotter and potentially fires and cyclones will be more intense. Consequently, there is an increased probability of fires penetrating into rainforest vegetation resulting in a shift from fire-sensitive vegetation to communities dominated by fire-tolerant species; and changing rainforest disturbance regime as cyclones become more intense) (Hughes 2011, Steffen et al. 2009). Changes in the timing of seasons (e.g., extended summer) could cause change in the seasonal response of plants, and alterations to species ranges and abundances (Hoegh-Guldberg et al. 2018).

Alpine/ Montane Areas

Alpine systems are generally considered to be among the most vulnerable to future climate change (Hughes 2003). The extent of true alpine habitat in Australia is very small (0.15% of the Australian land surface) with limited high-altitude refuge (Hughes 2003). Australian alpine regions are home to a variety of alpine vertebrates who rely on snow cover for their survival. There is evidence of a reduction in populations of dusky antechinus, broad-toothed rats, and the mountain pygmy possum. The first two species are active under the snow throughout winter and are therefore subject to increased predation by foxes when snow is reduced (Hughes 2003). The pygmy possum depends upon snow cover for stable, low temperatures during hibernation (Hughes 2003).

Marine Ecosystems

Average sea surface temperature in the Australian region has warmed by 1.05°C since 1900, with eight of the 10 warmest years on record occurring since 2010 (BoM and CSIRO 2022). A warming ocean affects the global ocean and atmospheric circulation, the cryosphere, global and regional sea levels, and causes losses in dissolved oxygen, impacts on marine ecosystems (BoM and CSIRO 2022), including changes to species abundance, community structure and increased frequency and intensity of thermally induced coral bleaching events (CSIRO 2017a).

Oceanic warming has also served to alter ocean currents around Australia. In response to both ocean warming and stratospheric ozone depletion the East Australian Current has increased in strength by about 20% between 1978 and 2005 (Cai and Cowan 2006). Sea-surface temperatures are projected to continue to increase, with estimates of warming in the Southern Tasman Sea of between 0.6 to 0.9°C and between 0.3 to 0.6°C elsewhere along the Australian coast by 2030 (Church et al. 2006).

Global mean sea level increased by 0.20 m between 1901 and 2018. The average rate of sea level rise was 1.3 mm/year between 1901 and 1971, increasing to 1.9 mm/year between 1971 and 2006, and further increasing to 3.7 mm/ year between 2006 and 2018. Human influence was very likely the main driver of these increases since at least 1971 (IPCC 2023).

Global mean sea level is predicted to rise between 0.18 m and 0.23 m by 2050, and between 0.38 m and 0.77 m by 2100 (IPCC 2021). This global mean sea level rise is primarily caused by thermal expansion and mass loss from glaciers and ice sheets, with minor contributions from changes in land-water storage. Global mean sea level will continue to increase for centuries to millennia due to continuing deep ocean warming and ice sheet melt, and sea levels will remain elevated for thousands of years, at rates dependent on future emissions (IPCC 2023). This will lead to some coastal inundation affecting mangroves, salt marshes and coastal freshwater wetlands. Furthermore, as CO_2 is gradually absorbed by oceans and fresh water, the water becomes more acidic, which increases the solubility of

calcium carbonate, the principal component of the skeletal material in aquatic organisms (Steffen et al. 2009).

Below is a summary of potential climate change impacts to two key marine ecosystems - mangroves and coral reefs, other marine ecosystems are summarised in Table 16.

Mangroves

Mangrove ecosystems in Australia will face higher temperatures, increased evaporation rates and warmer oceans (McInnes 2015) as well as an associated sea-level rise (Hoegh-Guldberg et al. 2018). Modelling indicates an increased likelihood of future severe and extended droughts across parts of Northern Australia (Dai 2013). Consequently, mangrove ecosystems may increase their southern range as a result of warmer temperatures. However, higher temperatures and evaporation rates, and extended droughts could lead to die-offs in northern Australia and a change in mangrove distribution and abundance (Duke et al. 2017). Mangrove systems should cope with rising sea-level by accumulating more peat or mud which will give them the opportunity to adjust to a rising sea level (Field 1995).

Coral Reefs

Climate change has emerged as a threat to coral reefs, with temperatures of just 1°C above the long-term summer maximum for an area over 4–6 weeks being enough to cause mass coral bleaching and mortality (Baker et al. 2008, Hoegh-Guldberg 1999, Hughes et al. 2017, Spalding and Brown 2015). Coral mortality or die off following coral bleaching events can stretch across thousands of square kilometres of ocean (Gilmour et al. 2016, Hoegh-Guldberg 1999, Hughes et al. 2017). The impacts associated with a warming ocean, coupled with increasing acidification, are expected to undermine the ability of tropical coral reefs to provide habitat for fish and invertebrates, which together provide a range of ecosystem services (e.g., food, livelihoods, coastal protection) (Hoegh-Guldberg et al. 2018). Coral reefs are projected to decline by 70–90% as a result of 1.5°C of global warming (IPCC 2023).

Table 15: Overview of Impacts of Climate Change to the Future Vulnerability of Particular Taxa (modified after Steffen et al 2009)

Taxa	Potential Vulnerability
Mammals	Narrow-ranged endemics susceptible to rapid climate change in-situ; changes in competition between grazing macropods in tropical savannas mediated by changes in fire regimes and water availability; herbivores affected by decreasing nutritional quality of foliage as a result of CO_2 fertilisation.
Birds	Changes in phenology of migration and egg-laying; increased competition of resident species; breeding of waterbirds susceptible to reduction; top predators vulnerable to changes in food supply; rising sea levels affecting birds that nest on sandy and muddy shores, saltmarshes, intertidal zones, coastal wetlands, and low-lying islands; saltwater intrusion into freshwater wetlands affecting breeding habitat.
Reptiles	Warming temperatures may alter sex ratios of species with environmental sex determination to cope with warming in-situ.
Amphibians	Frogs may be the most at-risk terrestrial taxa. Amphibians may experience altered interactions between; pathogens, predators, and fires.

Taxa	Potential Vulnerability
Fish	Freshwater species vulnerable to reduction in water flows and water quality; limited capacity for freshwater species to migrate to new waterways; all species susceptible to flow-on effects of warming on the phytoplankton base of food webs.
Invertebrates	Expected to be more responsive than vertebrates due to short generation times, high reproduction rates and sensitivity to climatic variables.
Plants	Climate change may impact various functional dynamics of plants due to changes in; increasing CO_2, fires, plant phenology and specific environmental characteristics.

Table 16: Projected Impacts of CO_2 Rise and Climate Change on Australian Ecosystems (modified after Steffen et al 2009)

Key Component of Environmental Change	Projected Impacts on Ecosystems
Coral reef	
CO_2 increases leading to increased ocean acidity	Reduction in ability of calcifying organisms, such as corals, to build and maintain skeletons.
Sea surface temperature increases, leading to coral bleaching	If frequency of bleaching events exceeds recovery time, reefs will be maintained in an early successional state or be replaced by communities dominated by microalgae.
Oceanic systems (including planktonic systems, fisheries, sea mounts and offshore islands)	
Ocean warming	Many marine organisms are highly sensitive to small changes in average temperature (1-2 degrees), leading to effects on growth rates, survival, dispersal, reproduction, and susceptibility to disease.
Changed circulation patterns, including increase in temperature stratification and decrease in mixing depth and strengthening of the East Australian Current	Distribution and productivity of marine ecosystems is heavily influenced by the timing and location of ocean currents; currents transfer the reproductive phase of many organisms. Climate change may suppress upwelling in some areas and increase it in others, leading to shifts in location and extent of productivity zones.
Changes in ocean chemistry	Increasing CO_2 in the atmosphere is leading to increased ocean acidity and a concomitant decrease in the availability of carbonate ions.
Estuaries and coastal fringe (including benthic, mangrove, saltmarsh, rocky shore, and seagrass communities)	
Sea level rise	Landward movement of some species as inundation provides suitable habitat, changes to upstream freshwater habitats will have flow-on effects to species.
Increase in water temperature	Impacts on phytoplankton production will affect secondary production in benthic communities.
Savannas and grasslands	
Elevated CO_2	Shifts in competitive relationships between woody and grass species due to differential responses.
Increased rainfall in north and northwest regions	Increased plant growth will lead to higher fuel loads, in turn leading to fires that are more intense, frequent and occur over large areas.
Tropical rainforests	

Key Component of Environmental Change	Projected Impacts on Ecosystems
Warming and changes in rainfall patterns	Increased probability of fires penetrating into rainforest vegetation resulting in shift from fire-sensitive vegetation to communities dominated by fire-tolerant species.
Changes in length of dry seasons	Altered patterns of flowering, fruiting and leaf flush will affect resources for animals.
Rising atmospheric CO_2	Differential response of different growth forms to enhanced CO_2 may alter structure vegetation
Temperate forests	
Potential increases in frequency and intensity of fires	Changes in structure and species composition of communities with obligate seeders may be disadvantaged compared with vegetative resprouters.
Warming and changes in rainfall patterns	Potential increases in productivity in areas where rainfall is not limiting; reduced forest cover associated with soil drying projected for some Australian forests.
Inland waterways and wetlands	
Reductions in precipitation, increased frequency and intensity of drought	Reduced river flows and changes in seasonality of flows.
Changes in water quality, including changes in nutrient flows, sediment, oxygen and CO_2 concentration	May affect eutrophication levels, incidence of blue-green algal outbreaks.
Sea level rise	Saltwater intrusion into low-lying floodplains, freshwater swamps and groundwater; replacement of existing riparian vegetation by mangroves.
Arid and semi-arid regions	
Increasing CO_2 coupled with drying in some regions	Interaction between CO_2 and water supply critical, as 90% of the variance in primary production can be accounted for by annual precipitation.
Shifts in seasonality or intensity of rainfall events	Any enhanced runoff redistribution will intensify vegetation patterning and erosion cell mosaic structure in degraded areas. Changes in rainfall variability and amount will also impacts on fire frequency. Dryland salinity could be affected by changes in the timing and intensity of rainfall.
Warming and drying, leading to increased frequency and intensity of fires	Reduction in patches of fire-sensitive mulga in spinifex grasslands potentially leading to landscape-wide dominance of spinifex.
Alpine/Montane areas	
Reduction in snow cover depth and duration	Potential loss of species dependent on adequate snow cover for hibernation and protection from predators; increased establishment of plant species at higher elevations as snowpack is reduced.

Table 17: Summary of SoE Report Conclusions on Climate Change Impacts

Receptor	Biologically Important Behaviour
Mammals	Terrestrial mammals are subject to ongoing population declines due to climate change and changes within habitats.

Receptor	Biologically Important Behaviour
Birds	There is strong evidence of population declines in threatened bird species, waterbirds and migratory birds. Various extensive and persistent impacts contribute to declines, including climate change (particularly drought) and extreme events, habitat degradation, and invasive predators.
Reptiles	Reptile species in all areas of Australia have an increasing risk of extinction. Risk of extinction was recognised as primarily related to ongoing pressure from invasive predators, but compounded by pressure from habitat modification, climate change (particularly drought) and disease.
	Half of Australian freshwater turtle species are in drastic population decline due to climate change.
Amphibians	Droughts and fires are increasing pressures within habitats that impact amphibian species.
	The number of known threatened amphibian species, including those that are Critically Endangered in Australia, is increasing. Drought and fire are recognised as increasing pressures contributing to this decline.
Fish	Freshwater fish throughout Australia have more than a 50% risk of extinction in the next 20 years due to climate change and changes within freshwater habitats.
Invertebrates	Most threatened invertebrates are suffering from largescale habitat degradation and loss of biodiversity. Changes in regional temperature, humidity and rainfall impact their distribution, development and reproduction.
Plants	Habitat destruction is the leading cause of vulnerability within plant species. However, changes in temperature, rainfall and fire regimes are contributing threats to plant species.
	Alpine ecosystems and biodiversity in Australia are particularly vulnerable to climate change that affects snow depth and the spatial and temporal extent of snow, which have all declined since the late 1950s.

Socio-economic

Changes to climate can result in impact to social receptors that have values which include the ecological receptors previously discussed. This includes KEFs and AMPs. Climate change also impacts on the functions, interests or activities of other users which rely on ecological values, including commercial and recreational fisheries and tourism. A temperature change of between 0.9°C to 2.0°C is forecast to reduce fisheries yield as the maximum catch potential around Australia by between 3% and 10% (IPCC 2023).

6.3.4 National and International Agreements and Frameworks Relevant to GHG Management

This section describes the relevant key national and international agreements and frameworks relevant to GHG management, including how these environmental requirements are relevant to the activity.

6.3.4.1 Paris Agreement

The United Nations Framework Convention on Climate Change came into force in 1994 and has been ratified by 197 countries. The convention established a goal of preventing dangerous anthropogenic

interference with the climate system. Subordinate treaties and agreements have been ratified by parties to the convention, including the Paris Agreement, which was agreed under the convention at the 21st Conference of the Parties in 2015.

The primary purpose of the Paris Agreement is to strengthen the global response toward climate change. Specifically, the Agreement seeks to substantially reduce GHG emissions to limit the global temperature increase in this century to 2oC, while pursuing efforts to limit the increase even further to 1.5°C (UNFCCC 2020). The Paris Agreement is legally binding, and signatories are reviewed every five years with the submission of an updated national climate action plan, known as Nationally Determined Contribution (NDC).

The Paris Agreement is set up through articles (UNFCCC 2020), with each article focusing on a certain commitment. Some key articles that are committed in the Paris Agreement are:

- Article 2 – Long-term temperature goals
    - Limiting the global temperature increase to well below 2°C, with preference and most efforts toward keeping it below 1.5°C.
- Article 4 – Mitigation
    - The agreement establishes binding commitments by all parties to prepare, communicate and maintain a NDC and to pursue domestic measures to achieve said NDC.
- Article 9, 10, 11 – Finance, technology, and capacity-building support
    - Obligations of developed nations to support the efforts of developing nations to build clean and climate-resilient futures.
    - In addition to reporting on finance already provided, developed nations commit to submit indicative information on support every two years.
    - Technology framework established under the agreement, and capacity-building activities will be strengthened through inter alia, enhanced support for capacity building actions in developing nations and appropriate institutional arrangements.
    - Climate change education, training, public awareness, participation, and access to information.

Australia has ratified the Paris Agreement and has adopted NDCs that can be monitored and reported on as part of the 5-year stocktake. At the Paris conference in 2016, Australia announced its first NDC to reduce GHG emissions by 26-28% below 2005 levels by 2030. This commitment was reaffirmed in 2020 after the 5-year review and further commitments were made in 2021 to reach net-zero emissions by 2050 and inscribe low emissions technology stretch goals.

In May 2022, the elected Labor government made a goal of reducing Australia's GHG emissions by 43% below 2005 levels by 2030 and reaffirmed Australia's commitment to net zero emissions by 2050. This was lodged with the UNFCCC as an updated NDC as part of Australia's obligations under the Paris Agreement. NDCs under the Paris Agreement are legally binding, and Australia mainly focuses on Article 10 with a low-emissions technology led approach. Australia's NDCs are implemented through

schemes such as the Safeguard Mechanism and the Emissions Reduction Fund and Climate Change Bill 2022, in addition to continuous monitoring and focusing on alternatives to lower overall emissions.

6.3.4.2 National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015

One of the key statutory instruments for regulating Australia's GHG emissions in line with Australia's NDCs under the Paris Agreement, is the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth) (the Safeguard Mechanism) made under the NGERS Act and administered by the Clean Energy Regulator. The Safeguard Mechanism was developed to ensure that Australia's largest greenhouse gas emitters keep their net emissions below an emissions limit (a baseline). The Safeguard Mechanism currently applies to facilities that emit more than 0.1 $MtCO_2$-e per annum and requires annual emissions to be reported against a designated emissions 'baseline'.

Key elements of the mechanism include:

- Safeguard facilities must meet the reporting and record-keeping requirements of the NGER Act, including the Clean Energy Regulator's requirements for audits prior to baseline setting or to check compliance management.
- If a safeguard facility is likely to exceed its baseline, the responsible emitter must act, including by purchasing and/or surrendering Australian carbon credit units, to offset excess emissions.
- Penalties for non-compliance.

The Otway Gas Plant emissions are regulated under the Safeguard Mechanism through establishment of a cap (baseline) on emissions.

As the Safeguard Mechanism only applies to facilities that exceed 100,000 tonnes of Scope 1 emissions per annum, the Otway Offshore Facilities are not covered Safeguard Mechanism Facilities.

6.3.4.3 National Greenhouse and Energy Reporting Scheme

The NGER Scheme is a single national framework for reporting company information about GHG emissions, energy production, and energy consumption. Key NGER Scheme legislation includes the National Greenhouse and Energy Reporting Act 2007, the National Greenhouse and Energy Reporting Regulations 2008, and the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

The NGER Act provides a single, national framework for the reporting and distribution of information related to GHG emissions, energy production, and energy consumption. Beach reports direct emissions associated with the Otway Offshore Operations and Otway Gas Plant under the NGER Act.

6.3.4.4 Intergovernmental Panel on Climate Change (IPCC) 6th Report

The IPCC released its sixth assessment consisting of four reports,

- Climate Change 2021: The Physical Science Basis, released in August 2021 (IPCC 2021)
- Climate Change 2022: Impacts, Adaptation and Vulnerability, released in February 2022 (IPCC 2022a)

- Climate Change 2022: Mitigation of Climate Change, released in April 2022 (IPCC 2022b)
- Climate Change 2023: Synthesis Report, released in March 2023 (IPCC 2023)

The four releases of the report relate climate change and anthropogenic influence as well as deduce the impact that climate change has had on ecosystems, biodiversity, humans, and cities, and inform the 2023 Global Stocktake under the United Nations Framework Convention on Climate Change. The Physical Science Basis IPCC Report, released in August 2021, was the first to unequivocally relate climate change to human influences and the use of hydrocarbon fuels. Surface temperatures have increased at a rapid rate since 1970 compared to any other 50-year period in the last 2,000 years. The rapid changes that have occurred since the industrial revolution are unprecedented, even with the research on ice boreholes and the subsequent calculations of historical CO_2 concentrations. The IPCC states with high confidence that in 2019, atmospheric CO_2 concentrations were higher than anytime in at least 2 million years, along with very high confidence that concentrations of CH_4 and N_2O far exceeding intensities from at least 800,000 years (IPCC 2021).

The sixth assessment report presents a number of scenarios to understand climate response to a range of GHG emissions levels. The best-case scenario, scenarios with very low and low GHG emissions and CO2 emissions decreases to net zero around or after 2050 (IPCC 2021), aligns with Beach's aspiration to achieve net zero Scope 1 and Scope 2 GHG emissions by 2050 and its interim target to reduce Beach GHG emissions intensity.

6.3.4.5 International Energy Agency World Energy Outlook

The International Energy Agency annually publishes a range of climate-related scenarios in its "World Energy Outlook" report. These scenarios model energy supply and demand under a range of different policy settings.

Three future scenarios and the resulting GHG emissions have been modelled in World Energy Outlook 2022 (IEA 2022):

- Net Zero Emissions by 2050 (NZE) Scenario
- Announced Pledges Scenario
- Stated Policies Scenario.

Common to each scenario is rising demand for energy, driven by economic and demographic forces. How this demand is met varies markedly across the scenarios, depending on the policy choices made by governments, which, in turn, shape investment decisions made by the public and private sectors, and the ways in which individual consumers meet their energy needs.

The NZE Scenario defines a set of assumptions intended to map a pathway to net zero CO2 emissions from energy and industrial processes by 2050, and to limit temperature rise to 1.5°C above pre-industrial levels. Therefore the NZE Scenario is aligned with the Paris Agreement temperature goals. As the Announced Pledges Scenario and Stated Policies Scenario are not aligned with the objectives of the Paris Agreement, they are not considered further in this EP.

In the NZE Scenario, limiting this temperature rise is to be achieved by reducing energy-related emissions by 1.3 Gt CO2-e on average every year until 2050. The NZE Scenario determines energy

supply and demand and focusses on the actions needed by the energy sector to achieve deep reductions in energy-related emissions, alongside universal access to modern energy by 2030. It examines the measures needed to curb growth in demand including energy and materials efficiency.

The declines in fossil fuel demand in the NZE Scenario stem primarily from a major surge in clean energy investment (from around USD 1.2 trillion in recent years to USD 4.2 trillion in 2030). Some investment in existing supply projects continues in the NZE Scenario to ensure supply does not fall faster than the decline in demand.

Production of gas from the Beach Otway Gas Plant is critical in ensuring Victoria's energy security as demand for gas is expected to continue in Victoria and the south-eastern states particularly as a result of the decline in consumption of more emission intensive coal associated with the closure of coal-fired power stations. Natural gas is the cleanest burning and fastest growing fossil fuel. As a result of its lower emissions intensity, coal-to-gas switching has avoided more than 500 Mt CO2-e emissions over the 2011-2018 period, or around 750 Mt CO2-e by 2020 (IEA 2019). It is estimated that approximately 1.2 Gt of CO2 could be avoided by switching from coal to existing gas-fired plants, assuming a supportive relative pricing and government policies (IEA 2019).

6.3.5 Beach Environmental Management System Relevant to GHG Emissions

Section 7 Implementation Strategy of the EP details the components of the Beach Operations Excellence Management System (OEMS) relevant to the management of the petroleum activity covered by this EP. Beach's climate change framework sits within their OEMS. Table 18 provides a summary of the Beach OEMS components relevant to the management of GHG emissions.

Table 18: Beach OEMS Components Relevant to the Management of GHG Emissions

Beach OEMS Component	Description	Contribution to Managing Climate Change
Corporate Policies		
Beach Climate Change Policy	Beach's climate change policy commitments include: • Measuring and reporting carbon emissions as required by regulatory requirements. • Integration of climate risks into project decision-making. • Evaluating investment decisions to potential changes in global climate policy and changes in climate. • Setting targets to encourage innovation and drive reductions in our carbon.	This public published policy specifies that Beach's top management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation. It identifies that the Board Risk, Corporate Governance and Sustainability Committee is responsible for overseeing the effectiveness of the policy. It formally expresses specific commitments related to climate change mitigation and adaptation. All Beach policies are approved by the Board.
Environmental Policy	The relevant commitments/aspects within Beach's Environment Policy are: • Establish environmental objectives and targets and implement programs to achieve them that will support continuous improvement.	Specifies that all environmental impacts will be proactively identified, assessed, and managed; and publicly reported against.

Beach OEMS Component	Description	Contribution to Managing Climate Change
	• Identify, assess, and control environmental impacts of our operations by proactive management of activities and mitigation of impacts. • Efficiently use natural resources and energy and engage with stakeholders on environmental issues. • Publicly report on our environmental performance.	All applicable legal and other requirements will be complied with and managed via Beach's OEMS. Commits to setting environmental objectives and targets, and a program of continuous improvement.
Sustainability Policy	The relevant commitments/aspects within Beach's Sustainability Policy are: • Ensuring an appropriate governance system is in place to maintain a sustainable business. • Assessing and addressing material social, environmental, climate and economic risks and the impact of our operations, and integrating these considerations into business planning. • Conducting business activities in an ethical and transparent manner. • Setting clearly defined targets, measuring, monitoring and reporting sustainability performance to support continuous improvement. • Complying with relevant legislation, standards and procedures. • Providing information and training, as required, and encouraging the adoption of sustainable principles and practices.	Specifies that Beach's top management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation; and formally expresses specific commitments related to climate change mitigation and adaptation. It identifies Beach Executives and managers are responsible for leading the adoption of this policy and the integration of sustainability practices.
OEMS – Key Relevant Standards		
8.1 Risk Management Standard	Standard 8.1 defines Beach's requirements to mitigate and manage risk at all levels within the business. It defines the Risk Management Framework for identifying, understanding, managing and reporting risks. The framework defines the documents, training, tools and templates to be used, and the accountabilities to be applied in support of effective risk management. Risks to people, the environment, Beach's reputation, financial position and any legal risks are assessed through the framework. The methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, Risk Management – Principles and Guidelines).	The potential impact of GHG emissions is assessed using Standard 8.1 and the risk assessment process described in Section 6 of this EP.
10.1 Environment Management Standard	Beach has an Environmental Management Standard (EMS) that was issued for use in December 2020 with a review frequency of 3 years. The standard requirements that are included within the EMS include:	Within Beach's EMS, there are management standards that will directly manage climate change. Most notably under the standards for Biodiversity and Air Quality and Emissions. Where Beach

Beach OEMS Component	Description	Contribution to Managing Climate Change
	• General rules • Land Disturbance, Reinstatement and Rehabilitation • Biodiversity • Contaminated Land Management • Water Management • Air Quality and Emissions • Noise and Vibration • Amenity (Dust, Odour, Visual, Lighting); and • Waste	can manage emissions and protection to biodiversity, they will ensure that as much as they can. Notable standards for mitigating climate change include: 10.1.3.5 – Decisions to proceed with exploration, development, operation and closure activities must consider the presence of, and impact on, legally designated protected areas and be recorded. 10.1.6.3 – When assessing and selecting new plant and equipment, low emissions technology must be prioritised. 10.1.6.6 – An inventory of sources of air emissions including point, fugitive and mobile related emissions must be developed and maintained.
11.1 – Sustainability Standard	Standard 11.1 operationalises the requirements established by the Company's Sustainability Policy and other associated Beach policies. The Standard includes the following requirements: • Responsibility for steering the company's response on sustainability. • Completion of a Sustainability Report. • Monitoring market and societal trends and Beach's response to them. • Risk assessments to consider social, environmental, governance and economic risks. • Preparation of sustainability targets and initiatives. • Linkage to Project and Risk Management Systems.	Beach's senior management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation. The Sustainability Report allows Beach to publicly report the impacts of their activities in a transparent structured way that is transparent to stakeholders and other interested parties, incorporating recommendations from the Task Force on Climate Related Disclosures. Monitoring of trends interfaces closely with risk management and setting of targets and initiatives. In alignment with BTSD 8.1 (Risk Management Standard), operational and project level risk assessments ensures the Company continues to pursue sustainable activities and projects. The Project Management System ensures that Sustainability in Design is considered during the design phase of a project life cycle.
Leadership and Accountability		
Risk, Corporate Governance and Sustainability Committee	The Beach Energy Board has the Risk, Corporate Governance and Sustainability Committee (RiskCo) which provides oversight on sustainability at Beach.	Provides management review of the system and changing circumstances in order to inform decisions on actions needed for improvement.
Sustainability Steering Committee	The Sustainability Steering Committee sits under this. It is made up of all company executives as well as the Chief Executive Officer; and oversees the management and execution of sustainability	

Beach OEMS Component	Description	Contribution to Managing Climate Change
	performance and risks in the business. Both committees meet on a quarterly basis to discuss sustainability risks, opportunities, projects as well as performance against the targets set out in the sustainability reports. In respect to climate change, RiskCo's purpose is to assist the Board in the following: • Regularly reviewing material risks (including through detailed reviews, or deep dives) and management actions and consider that the residual risk is appropriate. • Monitoring and reviewing the company's policies and performance in relation to health, safety, environment, community, climate change and other sustainability matters. • Developing annual sustainability reporting, including public disclosures regarding material climate change risks. • Ensuring the effectiveness of the Climate Change Policy.	
Commitment to Emissions Reduction		
Net zero Scope 1 and 2 operated emissions	Beach has an aspiration to achieve net zero Scope 1 and 2 emissions by 2050. This aspiration was announced in Beach's Financial Year report 2021, the Full Year Results ASX release, as well as being stated on the company's website under "reducing emissions".	Beach is working towards this aspiration via the processes described in this document. Estimated actual operated FY22 emissions were 12% lower than FY18. Initiatives include: • LDAR surveys completed at all assets remedial actions being taken through the maintenance management system. • Equity stake in Moomba CCS Project. • Multiple emission reduction projects completed at operated facilities.
Corporate emissions reduction target	Beach has a stated, publicly available, objective to reduce company net equity emissions intensity by 35 per cent by FY30 against FY18 levels/ targets https://www.beachenergy.com.au/reducing-emissions/.	

6.3.6 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and Acceptability Assessment: Atmospheric Emissions	
ALARP decision context and justification	This EP is an amendment to the accepted EP (2022) and contains a change in Beach's emissions reduction target. This EP also identifies an increase in fugitive emissions from the facilities. These changes may be considered to pose an increased risk to the environment as the methodology used has changed. Beach has confirmed a commitment to a 35% reduction in net equity emissions intensity by 2035 against 2018 levels. Atmospheric emissions: ALARP Decision Context: Type A. Impacts from atmospheric emissions are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is

	minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. Changes to the fugitive emissions have an appropriate mitigative action identified and which is now in place. The new corporate emissions target will not result in an adverse environmental impact at the Otway Offshore Facilities as forecast emissions are predicted to remain relatively unchanged, supported by the commitment to reduce emissions at these facilities when reasonably practicable to do so, such as through application of leak detection and repair. As the impact consequence is rated as Minor (1) applying good industry practice is sufficient to manage the impact to ALARP. GHG emissions: ALARP Decision Context: Type B Impacts from GHG emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, but there is significant partner and media interest in GHG emissions form oil and gas activities including Beach's activities. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good industry practice control measures**
CM#3: MO 97: Marine Pollution Prevention – Air Pollution	Vessels will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: hold a valid International Air Pollution Prevention (IAPP) certificate and a current international energy efficiency certificate. have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI. engine NOx emission levels will comply with Regulation 13 of MARPOL 73/78 Annex VI. sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI.
CM#4: Maintenance Management System	Combustion equipment shall be maintained in accordance with in accordance with the maintenance management system to ensure efficient operation.
CM#5: Venting Procedures	Venting is undertaken as described in the Thylacine-A Platform Safety Case, including: Venting is conducted as per operational and maintenance isolation procedures. Emergency blow down system designed to blow down topside only. Fuel gas purge flow forms part of the arrival and departure checks. Drain vents purge set points set to meet the minimum operational requirements.
CM#6 Contractor Supplier HSE Prequalification and Capability Assessment	The tender evaluation for the IMR and support vessels contract will include an evaluation of air and GHG emissions management.

CM#7: Beach Sustainability Standard	General Requirement within the Standard requires Beach to assess and maintain a register of opportunities to reduce: • emissions • energy consumption • venting and flaring These opportunities will be included in the yearly budget cycle for review, assessment, and approval where reasonably practicable.
CM#8: Beach GHG Management Plan	Beach has developed and will progressively implement its GHG Management Plan which formalises the framework and specific techniques used to ensure that GHG emission related EPOs will be met over the life of the facility. The GHG Management Plan also outlines how monitoring of Scope 3 GHG emissions attributed to Beach's Otway asset will be undertaken for the life of the activity.
CM#9: Fugitive Leak Detection and Repair Program	Beach undertakes periodic leak detection and repair (LDAR) fugitive emissions surveys. The methodology used for several years at the Otway Gas Plant has now been extended to the offshore platform. During these surveys minor valve and flange leaks are repaired on the spot with more significant leak repairs requiring equipment intervention are managed through the corrective maintenance program. The Otway asset oversees rectification of leaks through its maintenance backlog management process with an appropriate KPI for monitoring the close-out of corrective work orders pertaining to leaks. For offshore infrastructure such as subsea wells, the IMR program identifies and repairs any fugitive leaks. Thus, Beach has now implemented an offshore LDAR fugitive emissions survey to align with the onshore program with the scope, methodology, frequency, and repair guidance detailed in the GHG Management Plan (CM#8).
CM#10: Emissions Monitoring	Beach is required to annually report their direct GHG emissions (Scope 1 and 2) as per the NGERS regulatory requirements. Beach will use this annual reporting process to internally compare Scope 1 GHG emissions generated by the Otway Offshore Operations against periodic, internal GHG emissions forecasts. Scope 3 emissions derived from use of product will be reviewed against those same forecasts, with this focus reflecting the proportional contribution of final product use to overall Otway asset Scope 3 emissions (refer to Section 6.3.1.1). Assessment of actual emissions against forecasts will feed into revised assumptions in future emissions forecasts and into the GHG Management Plan review and improvement processes.

Additional Controls Assessed

Control	Cost/Benefit Analysis	Control Implemented?
Use of low GHG fuels at the Thylacine-A Wellhead Platform	The Otway Gas Project design includes best practice GHG design. The original Otway Gas Project EES/EIS and Works Approval covered best practice design elements in the facility design which considered the hierarchy of control (Eliminate, reduce, offset). Options considered and not implemented due to high cost and/or feasibility are supply of power from shore (low GHG source), renewable energy generation (offshore wind or solar) and alternative fuels (LNG, Ammonia).	No

	Gas engines were selected as the primary power source, these reduce emissions and reduce cost of operations compared to diesel. Diesel maintained as a backup.	
Use of low GHG fuels for support and IMR vessels	Vessel that use low GHG fuels are relatively now and are not common in Australian waters. To bring vessels into Australia to support operations is an increased cost. Beach via its Contractor Supplier HSE Prequalification and Capability Assessment (CM#6) assesses suppliers emissions management and via this process would support low emission vessels if available.	Yes – as per CM#6: Contractor Supplier HSE Prequalification and Capability Assessment
Eliminate platform venting	A means to dispose of gas is required on the Thylacine-A Wellhead Platform for operability and safety requirements. Process vent was selected due to low rate of fugitive emissions per calendar year, simplicity and reliability given the unmanned platform philosophy. No reasonably practicable alternative methods for reduction or mitigation of vented or fugitive emissions have been identified (vapour recovery system and flare system have been assessed) that would further reduce the impacts. Other measures have grossly disproportionate cost to benefit.	No

Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability Assessment	
To meet the principles of ESD	Air emissions were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Giving consideration to economic development that safeguards the welfare of future generations, Otway Offshore Operations is considered to align with the following core objectives of ESD by: • Responding to the global energy transition, providing a clean and reliable energy source as gas is expected to play a key role in the future energy mix (e.g., partner with renewables). In addition, gas has the potential to contribute to an incremental reduction in global GHG emissions by displacing more carbon intensive power generation (e.g., coal), firming up renewables, or in hard-to-abate sectors. • Committing to controls for GHG emissions within operational control of Beach, given the uncertainty about future climate change trajectories. • Committing to controls for indirect GHG emissions that are controlled or influenced by Operator and connected to the operations of the Otway Offshore Operations. • Contributing to the UN Sustainable Development Goals of achieving universal access to energy. • Providing gas to customers within Australia that has ratified the Paris Agreement, and our responsible for accounting, reporting and reducing emissions that occur in its jurisdiction.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy, Climate Change Policy, Sustainability Policy, Risk Management Standard, Environment Management Standard and Sustainability Standard as detailed in Section 6.3.5.

	Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding atmospheric emissions or GHG emissions associated with the Otway Offshore Operations.
Other requirements	Climate variability and change is identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). As 'Loss of habitat caused by anthropogenic emissions of greenhouse gases' has been declared a Key Threatening Process under the EPBC Act. Such changes have the potential to affect listed and migratory species covered by conservation advice and management plans. Climate change is identified as a threat in the Wildlife Conservation Plan for Seabirds (CoA, 2020b). To ensure that Beach's activities are not inconsistent with these conservation advices, recovery plans and management plans and to support Australia's NDC commitments air emissions and GHG emissions will be managed in accordance with applicable legislative and other requirements including: • The adopted controls and acceptability assessment has considered regulatory and other guidance as detailed in Section 6.3.4, in particular requirements of: ◦ Paris Agreement ◦ National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 and Scheme ◦ Victorian Climate Change Act 2017 ◦ IPCC Sixth Assessment Report ◦ International Energy Agency World Energy Outlook • Providing gas to customers within Australia that has ratified the Paris Agreement.
Monitoring and reporting	Atmospheric and GHG emissions shall be recorded and reported in alignment with the *National Greenhouse and Energy Reporting Act* 2007 (NGER Act) and National Pollution Inventory. Scope 1 and Scope 3 GHG emissions, generated by the Otway Offshore Operations, will be compared annuall.y to the EP estimates detailed in EP Section 7.3.1.1 as per CM#10.
Acceptability outcome	**Acceptable**

6.4 Underwater Sound Emissions – Impulsive

6.4.1 Hazards

Impulsive underwater sound emissions will be generated by:

- Geophysical surveys

6.4.2 Predicted Environmental Impacts

Potential impacts of underwater sound emissions from geophysical activities to receptors are:

- Behavioural changes.
- Auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

Underwater impulsive sound emissions may impact the following biological receptors:

- Marine invertebrates including commercial species such as squid, rock lobster and giant crab.
- Fish (with and without swim bladders) including commercial species such as sharks and scalefish.
- Marine reptiles.
- Marine mammals.

6.4.3 Consequence Evaluation

Single-beam echo sounder

A single-beam echo sounder (SBES) typically has a frequency range between 120 and 710 kHz and a maximum sounding rate of 20 Hz. The beam width varies between 10 (120 kHz) and 2.8 (710 kHz). The single beam bathymetry received sound exposure level typically does not exceed 160 dB.

Multi-beam echo sounder

The frequency range of the multi-beam echo sounder (MBES) is typically 200–500 kHz (classified as high frequency) with a maximum angular coverage of 160°. The maximum source levels are about 236–242 dB re 1 µPa @ 1 m for the 1° and 2° beams (DoC, 2016).

Side scan sonar

Side scan sonar (SSS) typically operates in the 100–500 kHz frequency range (classified as high frequency). The maximum source levels are about 210-220 dB re 1µPa @ 1 m (DoC, 2016). The SSS towfish is typically towed 10–15 m above the seabed (depending on water depth and the exact frequency) at a distance of about 150- 200 m behind the vessel.

Sub-bottom profiler

Acoustic emissions from sub-bottom profiler (SBP) are typically in the frequency range of 0.05 to 12 kHz, with peak sound pressure level (SPL) of up to 220 dB re 1µPa @ 1 m. There are three different types of SBP, which exhibit a trade-off of in resolution versus depth of penetration based on the frequency of the acoustic signal:

1. CHIRP – uses an FM signal across a full range of frequencies, typically either 2-16 kHz or 4-24 kHz (low to high frequency). The maximum source levels of a CHIRP are about 200– 205 dB re 1 µPa @ 1 m (DoC, 2016).

2. High-frequency boomers – the typical frequency spectrum of boomer systems ranges between 0.2 and 10 kHz, with an effective bandwidth of 1 to 10 kHz (low to high frequency). The sound source level can vary from 100 to 220 dB re 1 µPa @ 1 m.

3. Medium-frequency sparkers – the generated frequencies are generally between 50 Hz (0.05 kHz) and 4 kHz (low to high frequency). The sound source level is typically between 215 and 225 dB re 1 µPa @ 1 m.

Based on a review of the geophysical equipment to be used it was identified that the boomer and SBP were most relevant to the assessment of potential impacts to receptors, due to their operating frequencies and source sound levels. Modelling results for the Otway geophysical survey (McPherson and Wood 2017) have been used as the modelled locations are within the Otway Operation Area and the equipment will be similar.

The modelling study assessed six locations as detailed in Table 19 and Figure 13. Table 19 details those locations relevant to the Otway Operations infrastructure areas.

To assess whether an impact may occur modelled received sound levels were compared to receptor noise effect criteria (Table 20). These criteria are based on published scientific research and papers as detailed in and within the relevant receptor section. In lieu of any noise criteria specific to geophysical surveys, criteria that is applied to seismic surveys have been used.

Table 19: Acoustic Modelling Locations Applicable to the Seabed Assessment Locations

Modelled Location	Water Depth (m)	Otway Operations Area
Site 1: THY MID PT	100.5	Thylacine
Site 2: MURCH DDIP	129.5	NA
Site 3: G3	85	Geographe
Site 4: ARTISAN	71.6	Artisan
Site 5: VICP69 NTH	72.8	N/A
Site 6: VICP69 MEEKI	79.1	N/A

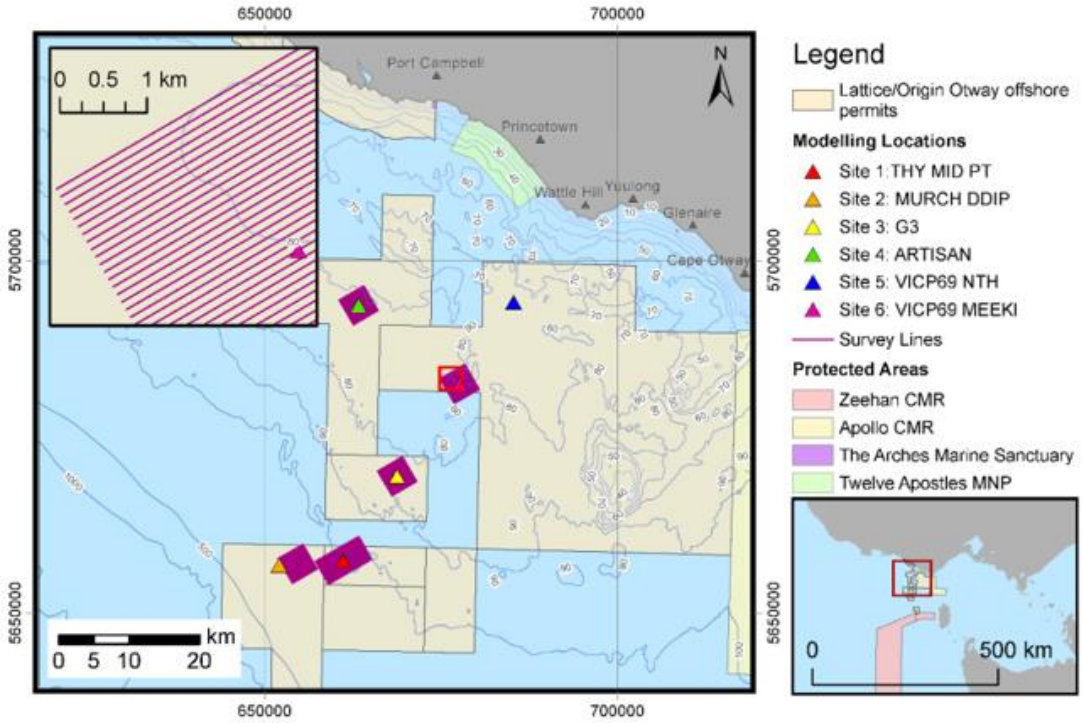

Figure 13: Noise Modelling Locations

Table 20: Effect Criteria Used and the Applicable Results for Representative Single Pulse Sites and for Accumulated SEL Scenarios

Receptor	Noise Effect Criteria	Boomer Maximum R_{max} Distance (m)	SBP Maximum R_{max} Distance (m)	Noise Effect Criteria Reference
Invertebrates: effect at the seafloor	186–190 dB SEL 192–199 dB SEL_{24h} 209–212 dB PK-PK	Not reached Not reached Not reached	Not reached Not reached Not reached	Day et al. 2016
Invertebrates: no effect at the seafloor	202 dB PK-PK	Not reached	Not reached	Payne et al. 2008
Lobster: no effect at the seafloor	183 dB SEL	Not reached	Not reached	McCauley and Duncan 2016
Squid: behavioural	166 dB SPL	36	Not reached	McCauley et al. 2000
Fish (swim bladder): mortality/potential mortal injury	>207 dB PK or 207 dB SELcum[1]	1.6 Not reached	0.3 Not reached	Popper et al. 2014
Fish (swim bladder): recoverable injury	>213 dB PK or >216 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (no swim bladder): mortality/ potential mortal injury	>213 dB PK or >219 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (no swim bladder): recoverable injury	>213 dB PK or >216 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (swim bladder or no swim bladder): TTS	>186 dB SELcum[1]	Not reached	Not reached	Popper et al. 2014
Turtle: behavioural	166 dB SPL	36	Not reached	NSF 2011
Turtle: mortality/potential mortal injury	>207 dB PK or 210 dB SELcum[1]	1.6 Not reached	0.3 Not reached	Popper et al. 2014
Marine mammals: behavioural	160 dB SPL	145	2	NMFS 2013 NOAA 2019
Low-frequency cetaceans: PTS (humpback and pygmy blue whales)	219 dB PK 183 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Low-frequency cetaceans: TTS (humpback and pygmy blue whales)	213 dB PK 168 dB SEL_{24h}	Not reached 10	Not reached 10	NMFS 2018
Mid-frequency cetaceans: PTS (dolphins, beaked whales, sperm whales)	230 dB PK 185 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Mid-frequency cetaceans: TTS (dolphins, beaked whales, sperm whales)	224 dB PK 170 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018

Receptor	Noise Effect Criteria	Boomer Maximum R_{max} Distance (m)	SBP Maximum R_{max} Distance (m)	Noise Effect Criteria Reference
High-frequency cetaceans: PTS (pygmy and dwarf sperm whales)	202 dB PK 155 dB SEL_{24h}	4.5 Not reached	0.6 Not reached	NMFS 2018
High-frequency cetaceans: TTS (pygmy and dwarf sperm whales)	196 dB PK 140 dB SEL_{24h}	8.9 Not reached	1.2 Not reached	NMFS 2018
Phocid pinnipeds: PTS (seals)	218 dB PK 185 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Phocid pinnipeds: TTS (seal)	212 dB PK 170 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018

Note 1: Popper et al. 2014 do not defined an accumulation period. For this assessment 24 hrs was used based on the independent, expert peer review by Popper (Santos, 2018) that concluded that a 24-hour period to assess SELcum and any associated effects is likely to be conservative for assessing the potential effects to fish.

6.4.3.1 Marine Invertebrates

There has been a number of comprehensive reviews of seismic noise impacts to invertebrates such as Carroll et al. (2017) and Edmonds et al. (2016). Available literature suggests particle motion, rather than sound pressure, is a more important factor for crustacean and bivalve hearing. There are currently no defined noise effect criteria for invertebrates and hence the results from the Day et al. (2016) study on acoustic impacts from seismic exposure on southern rock lobsters (*Jasus edwardsii*) are typically used. The study found that sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes (possibly indicative of decreased immune response function), were observed after exposure to measured received sound levels of:

- single-pulse SEL: 186–190 dB re 1 $\mu Pa^2.s$
- accumulated SEL: 192–199 dB re 1 $\mu Pa^2.s$
- peak-peak pressure: 209–212 dB re 1 µPa.

Payne et al (2007) found no effects to the American lobster (*Homarus americanus*) in righting time or haemolymph biochemistry but a possible reduction in calcium after exposure to received noise levels of 202 dB re 1 µPa (PK-PK). Thus, the Payne et al (2007) level is applied as a no effect criteria. This assessment also used the no effect level proposed by McCauley and Duncan (2016) for rock lobsters of accumulated SEL 183 dB re 1 $\mu Pa^2.s$.

Table 20 details that the sound levels from the representative boomer and SBP do not reach any of the effect or no effect criteria for invertebrates at the seafloor.

McCauley et al. (2000) assessed the effects of air gun noise on caged squid (*Sepioteuthis australis*). No sub-lethal injury or mortality as a result of exposures in this study was observed. Several squid showed alarm responses to the start-up of an airgun by firing their ink sacs and/or jetting away from the source, but this was not observed for similar or greater levels if the signal was ramped up. General habituation was observed with a decrease in alarm responses with subsequent exposures. During the trial the squid showed avoidance to the airgun by keeping close to the water surface at the end of the

cage furthest from the airgun (within the sound shadow). McCauley suggests a threshold of 166 SPL would give an indication of the extent of disruption of a seismic survey by significant alteration in swimming patterns. Table 20 details that the noise effect criteria at which an alteration of swimming patterns may occur is predicted within 36 m of the boomer and not reached for the SBP.

Based on the modelling no mortality or injury effects to invertebrates including commercial squid, octopus, rock lobster and giant crab species are predicted.

6.4.3.2 Fish

Noise effect criteria for fish are based on the presence of a swim bladder. Typically, site-attached and demersal fish have a swim bladder, whereas pelagic fish do not. As noise effect criteria for sharks does not currently exist, they are assessed as fish without swim bladders. Noise effect criteria used in this assessment for fish are from the American National Standards Institute (ANSI) accredited report of sound exposure guidelines for fishes and sea turtles (Popper et al., 2014). These guidelines defined quantitative effect criteria for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- TTS.

Table 20 details the noise effect criteria from Popper et al., 2014 and the distances at which modelling estimated they could be reaced for fish with and without a swim bladder. In summary:

- The noise effect criteria for mortality/potential mortal injury is predicted for fish with a swim bladder at a maximum distance of 1.6 m and for fish without a swim bladder at 0.6 m.
- The noise effect criteria for recoverable injury is predicted for fish with a swim bladder and without a swim bladder at a maximum distance of 0.6 m.
- The noise effect criteria for TTS for fish with and without a swim bladder was not reached.

Studies to date have not shown mortality in relation to potential impact to fish from impulsive noise, though prolonged or extreme exposure to high-intensity, low-frequency sound, may lead to physical damage such as threshold shifts in hearing or barotraumatic ruptures (Carroll et al., 2017). Based on the modelling and that the geophysical surveys will not result in prolonged or extreme exposure to fish it is unlikely that injury impacts to fish would occur.

The Operational Area does not overlap any areas where site-attached fish species are likely to be present, thus it would be expected that any impacts to fish, including sharks, would be limited to behavioural impacts such as startle response or avoidance behaviour as the vessel moves through an area. Thus, behavioural impacts to fish would be temporary and unlikely to have a significant impact on individuals or at a population level.

6.4.3.3 Marine turtles

Noise effect criteria used in this assessment for injury to turtles are from the ANSI accredited report of sound exposure guidelines for fishes and sea turtles (Popper et al., 2014). Table 20 details the noise effect criteria from Popper et al. 2014 and the distances at which modelling estimated they could be reached. In summary:

- The noise effect criteria for injury to turtles were not reached for the SBP.
- The noise effect criteria for injury to turtles for the boomer is predicted at a maximum distance of 1.6 m for the peak sound pressure level (PK) while the noise effect criteria based on the sound exposure level (SEL) is not reached.

Based on limited data regarding noise levels that illicit a behavioural response in turtles, the United States National Marine Fisheries Service criterion of 166 dB re 1 µPa (SPL) is typically applied (NFS, 2011). For the boomer this noise effect criteria is predicted at a maximum distance of 36 m but was not reached for the SBP.

Three marine turtle species may occur within the operational area. No BIAs or habitat critical to the survival of the species occur within the operational area. Impacts to turtles within the area where the survey is occurring are likely to be restricted to avoidance behaviour as the vessel moves through an area and unlikely to result in any injury due to the very small distance (1.6 m) within which noise levels reach the noise effect criteria for injury. Thus, behavioural impacts to turtles would be temporary and unlikely to have a significant impact on individuals or at a population level.

6.4.3.4 Marine mammals

Noise effect criteria used in this assessment for impacts to marine mammals are from:

- The United States National Marine Fisheries Service (NMFS, 2013; NOAA 2019) acoustic threshold for behavioural effects in marine mammals of 160 dB re 1 µPa (SPL).
- National Marine Fisheries Service (NMFS, 2018) thresholds for the onset of PTS and TTS. These criteria as details in Table 20 are based on dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted $_{24h}$ refers to the accumulation period for calculating SEL. The peak sound pressure level (PK) criterion is not frequency weighted whereas the SEL_{24h} is frequency weighted according to the marine mammal species hearing group.

Two species of pinniped may occur within the operational area: the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Twenty eight cetacean species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects the migration and reproduction BIAs for the southern right whale and a foraging BIA for the pygmy blue whale.

Table 20 details the noise effect criteria and the distances at which modelling estimated they could be reached. In summary:

- The acoustic threshold for behavioural effects in marine mammals is predicted at a maximum of 2 m for the SBP and 145 m for the boomer.
- For low-frequency cetaceans the noise effect criteria for PTS is not reached. The noise effect criteria for TTS is predicted at a maximum of 10 m for the SBP and boomer for the 24-hour cumulative SEL. The noise effect criteria for TTS for the single pulse was not reached.
- For mid-frequency cetaceans the noise effect criteria for PTS and TTS is not reached.
- For high-frequency cetaceans the noise effect criteria for PTS is predicted for the single pulse at a maximum of 0.6 m for the SBP and 2.8 m for the boomer. The noise effect criteria for PTS for the 24-hour cumulative SEL was not reached. The noise effect criteria for TTS is predicted for the single pulse at a maximum of 1.2 m for the SBP and 5.5 m for the boomer. The 24-hour cumulative SEL noise effect criteria for TTS was not reached.
- For Otariid pinnipeds, such as fur-seals, the noise effect criteria for TTS and PTS where not reached.

Low frequency cetaceans

Several low frequency cetaceans may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects the migration and reproduction BIAs for the southern right whale and a foraging BIA for the pygmy blue whale.

For low-frequency cetaceans the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if foraging, resting, or migrating would be within 10 m of a moving vessel for 24 hours. Predicted impacts would, therefore, be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The severity of impact to low frequency cetaceans is assessed as moderate based on:

- Geophysical surveys can be managed to ensure that they will not be inconsistent with the Conservation Management Plan for the Blue Whale (CoADoE, 2015a) that details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area as:
    - the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if foraging, resting, or migrating would be within 10 m of a moving vessel for 24 hours.
    - the distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of displacement occurring as per the Guidance on Key Terms within the Conservation Management Plan for the Blue Whale (DAWE 2021a) that details mitigation measures must be implemented to reduce the risk of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur.

- The fin and sei whale's conservation advice (TSSC 2015f; TSSC 2015g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.

- The pygmy right whale Species Profile and Threats Database (DoE 2023p) in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat.

- The Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) identifies acute industrial noise, of which geophysical surveys would be classed, as a threat that is classified as a minor consequence which is defined as individuals are affected but no affect at a population level. PTS and TTS impacts and not predicted to southern right whales based on the distance to TTS effect criteria is 10 m. The distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of disturbance to southern right whale biologically important behaviours.

- Geophysical surveys can be managed to ensure that they will not be inconsistent with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) that details that actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance, as:

    - the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if resting, or migrating would be within 10 m of a moving vessel for 24 hours.

    - the distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of preventing southern right whales from utilising the area or cause injury (TTS and PTS) and/or disturbance.

Mid frequency cetaceans

Mid frequency cetaceans such as dolphins, sperm whales and beaked whales may occur in the operational area, but no BIAs of biologically important behaviours were identified. The noise effect criteria for TTS and PTS for these species was not reached, thus predicted impacts would be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The extent of the area of where mid frequency cetaceans may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to mid frequency cetaceans is assessed as Minor (1) based on:

- Impacts to mid frequency cetaceans are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.

- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.

- The area of impact is not within a BIA or habitat critical to the survival of a mid frequency cetacean species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

High frequency cetaceans

High frequency cetaceans such as pygmy and dwarf sperm whales may occur in the operational area, but no BIAs of biologically important behaviours were identified. The maximum distance for the PTS noise effect criteria is 2.8 m and for TTS is 5.5 m, thus predicted impacts would be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The extent of the area of where seals may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to seals is assessed as Minor (1) based on:

- Impacts to high frequency cetaceans are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.
- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.
- The area of impact is not within a BIA or habitat critical to the survival of a high frequency cetaceans species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

Pinnipeds

The Australian and New Zealand fur-seals may occur in the operational area but no BIAs or haul out areas were identified. The noise effect criteria for TTS and PTS for these species was not reached, thus predicted impacts would be limited to behavioural response such as avoidance of area while the geophysical survey is undertaken.

The extent of the area of where seals may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to seals is assessed as Minor (1) based on:

- Impacts to seals are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.
- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.

The area of impact is not within a BIA or habitat critical to the survival of a seal species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

6.4.4 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Underwater sound emissions

ALARP decision context and justification	ALARP Decision Context: Type B Impacts from geophysical impulsive sound emissions are well understood though there is the potential for uncertainty in relation to the level of impact. Geophysical activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests.
Adopted Control Measures	**Source of good practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels and helicopters. Vessels will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans. These regulations stipulate a safe operating distance of 300 m, however as per Section 6.5.5 this has been increased to 500 m to take into account the distance to the noise effect criteria for vessels. This is greater than the furthest noise effect distance of 145 m for geophysical surveys. As the geophysical survey vessel is manoeuvrable, even when the geophysical equipment is in the water this requirement, the 500 m distance can be applied. Maintaining a 500 m distance to all whales will ensure that impacts will be managed such that they can continue to utilise the area without injury and will not be displaced from biologically important behaviours such as foraging, migrating or reproduction.
CM#12a Geophysical survey pre-start visual observation	For geophysical surveys using SBP (boomer or sparker) a prestart visual observation period of 30 mins will be applied to 500 m prior to the start of the SBP (boomer or sparker) this is to ensure that no whales are within 500 m prior to starting the equipment. A 500 m distance is conservative as the furthest distance for noise effect criteria for the geophysical survey equipment was estimated at 145 m for behavioural effects. If during the prestart visual observation period, a whale is sighted within 500 m of the vessel the SBP equipment activation will be delayed until the whale has moved outside of the 500 m zone or 30 minutes has lapsed since the last whale sighting within 500 m. 30 minutes is sufficient time for the vessel and/or whale to have moved 500 m away and to account for blue whales that are capable of diving for periods upwards of 20 minutes. Once the survey has commenced CM#11 applies where the vessel is required to maintain a 500 m distance to all whales. SBP equipment will not be started at night if there have been three or more delays to the start-up of the equipment due to whales in the previous 24 hours. Applying a 500 m distance will ensure that impacts to whales will be managed such that they can continue to utilise the area without injury and are not displaced from biologically important behaviours such as foraging, migrating or reproduction. These controls will be applied to all seasons as a conservative measure to cover not only the peak foraging periods in the area (January to April) but the broader period when pygmy blue whales, and other whales such as the fin, pygmy right and sei may be in the area and when southern right whales are within the reproductive BIA approximately May – September and the migration BIA approximately April - October (DCCEEW 2023b).
CM#12b Geophysical survey Marine Mammal Observer	For geophysical surveys utilising SBP a dedicated MMO will be present on the vessel to undertake prestart visual observations and implement the 500 m distance to any whales.

	The MMO will have proven experience in whale observation, distance estimation and reporting.
CM#12c Geophysical survey adaptive management	If whale numbers are greater than expected such that pre-start observations are delayed three times in a 24-hour period or the vessel must move away from a whale or a pod of whales three times in a 24-hour period, a review of the controls in place will be undertaken by the Activity Offshore Representative, Activity Project Manager and Environment Advisor. The review will be documented and will be undertaken against the Implementation of the EPBC Act Policy 2.1 Part A requirements to identify if further controls need to be applied to ensure that impacts and risks are ALARP and within the defined acceptable level. The implementation of an adaptive management process will ensure that if numbers are greater than expected due to favourable conditions, impacts and risks can continue to be managed to ALARP and within the defined acceptable level.

Additional controls assessed

Control	Cost/Benefit Analysis	Control Implemented?
Seasonal timing	Blue whales are potentially in the foraging BIA within the Otway shelf waters from November through to June. Southern right whales may travel through the migration BIA, which the operational area overlaps, to and from the coastal reproduction BIA during April – October and be present in the coastal reproduction BIA, which the operational area overlaps, between May – September (DCCEEW 2023b). Thus, there is no period when there is not a whale undertaking a biologically important behaviour within the Otway region. The implementation of additional controls above the legislative requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans will be implemented to manage potential impacts to whales undertaking biologically important behaviour.	No
Implementation of the EPBC Act Policy 2.1 Shutdown Zones	Geophysical equipment operates at significantly lower source levels than a commercial seismic array, and thus the resulting sound levels are proportionally lower at comparable distances. EPBC Act Policy 2.1 was developed for seismic surveys with the aim of the policy to provide: • practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations. • a framework that minimises the risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours. • provide guidance to both proponents of seismic surveys and operators conducting seismic surveys about their legal responsibilities under the EPBC Act. Modelling has shown that received noise levels and distances to noise effect criteria for the geophysical survey are significantly lower than those for seismic surveys with the largest distance predicted to be 145 m for the behavioural noise effect criteria for marine mammals. The distances proposed in the policy to minimise the risk of acoustic injury to whales and risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours of 1 km, for the low power zone, and 500 m, for	No

	the shut-down zone, are significantly larger than the predicted distance of 145 m for the noise effect criteria for behavioural disturbance and 10 m for the noise effect criteria for TTS. As the vessel is continuously moving, the distance from the vessel to any marine mammal will exceed the small distances within which noise levels reach the noise effect criteria within seconds. Displacement due to behavioural impacts could occur up to 145 m from the source, and with a moving vessel the distances to the threshold criteria will occur quickly (within 3 minutes for a vessel travelling at approx. 8 km/hr). By the time a whale is sighted, and equipment shut down, it is likely the distance would have been covered and the whale has passed, therefore affording no benefit. As such, based on the small distances within which the noise effect criteria for marine mammals are met, impacts to whales can be managed such that they can continue to utilise the area without injury and are not displaced from biologically important behaviours such as foraging, migrating or reproduction, thus the implementation of shut-down zones does not afford any further benefit.	
Implementation of the EPBC Act Policy 2.1 Soft start	Soft starts are applied to seismic surveys to slowly ramp up the seismic source allowing fauna to move away from the source. No seismic source will be used for the activity and the geophysical equipment being used for the survey cannot be slowly ramped up.	No
Passive acoustic monitoring (PAM)	PAM is most useful in the detection of odontocetes such as sperm whales, dolphins and porpoise known to emit regular distinctive clicks and high frequency calls during long dives. PAM has limited utility in detecting lower frequency calls of baleen whales (such as blue whales, southern right whales) especially when in the presence of constant background low frequency sound such as that generated by the vessel towing the PAM system. Given the very low utility and associated unreliability of using PAM to inform mitigation decision making, any additional cost is considered disproportionate to the benefit gained.	No
Dedicated monitoring vessel	An additional dedicated vessel is not required as monitoring activities can be effectively conducted from the geophysical vessel. Cost is disproportionate to marginal environmental benefit.	No
Aerial surveillance	Aerial surveillance from aircraft or drones is not required as monitoring activities can be effectively conducted from the geophysical vessel. Cost is disproportionate to marginal environmental benefit.	No
Consequence rating	Moderate (2)	
Likelihood of occurrence	NA	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	Sound emissions were assessed as having a moderate consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.	
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy.	

	Activities will be undertaken in accordance with the Implementation Strategy (Section 8).
External context	There have been no stakeholder objections or claims regarding impulsive sound emissions.
Other requirements	Sound emissions will be managed in accordance with legislative requirements. Sound emissions will: • Not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (CoA 2017b). • Be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area (DoE2015b; DAWE 2021a). • Not impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015b). • Not impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC 2013a). Actions from the Conservation Management Plan for the Blue Whale (DoE 2015b; DAWE 2021a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Assessing the effect of anthropogenic noise on blue whale behaviour. Section 6.4.3.4 assesses the effects of anthropogenic noise from the activity on blue whale behaviour. • Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. Section 6.4.3.4 demonstrates that the activity can be conducted in a manner that is consistent with the conservation management plan and will not result in injury or displacement of pygmy blue whales from a foraging BIA. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Anthropogenic noise in biologically important areas will be managed such that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance. • Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to Southern Right Whales to the lowest possible level. Section 6.4.3.4 assesses the effects of anthropogenic noise from the activity on southern right whales and Section 6.5.5 includes consideration of national policy and guidelines relevant to geophysical surveys. • Quantify risks of anthropogenic underwater noise to Southern Right Whales, including behavioural disturbance, changes to vocalisations, and physiological effects to whales. Section 6.4.3.4 assesses the effects of anthropogenic noise from geophysical surveys on southern right whales.
Monitoring and reporting	Cetacean sightings will be recorded using the DCCEEW sighting sheets.
Acceptability outcome	**Acceptable**

6.5 Underwater Sound Emissions - Continuous

6.5.1 Hazards

Continuous underwater sound emissions will be generated by:

- Platform operations (venting, power, HVAC, crane usage etc.)
- Helicopter operations
- Subsea infrastructure
- Maintenance and repair activities
- Vessel operations

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

Sound will be generated by helicopters during take-off and landing on the Thylacine-A Wellhead Platform.

Underwater sound emissions are generated by liquid or gas flow though pipelines and valves, specifically wellheads and choke valve operations such as those found at the Geographe and Thylacine subsea facilities. The Thylacine-A Wellhead Platform is a fixed platform, with topside choke valves only, therefore does not generate underwater sound emissions.

Installation of rock bolts by divers and subsea tree top plate trimming with a disk cutter for any choke valve replacement work will also create sound while these activities are being undertaken.

6.5.2 Predicted Environmental Impacts

Potential impacts of underwater sound emissions from the Otway Offshore Operations are:

- Behavioural changes.
- Auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

6.5.3 EMBA

The sound EMBA is the area where sound levels are predicted to be above sound exposure criteria. Acoustic modelling undertaken to determine the sound EMBA is described below.

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

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

As different sound exposure criteria apply to these receptors, sound EMBAs for each receptor is defined in the receptor consequence sections to identify potential receptors that may be affected.

6.5.4 Consequence Evaluation

Helicopters

Helicopters are used to transport personnel to and from the platform. The presence of the helicopter and its associated sound field will be highly transient. On approach to the platform the helicopter will descend to the helideck where there is greatest potential to ensonify the water column. Sound pressure will be greatest at the sea surface and rapidly diminish with increasing depth. Helicopter engine sound is emitted at a range of frequencies generally, below 500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported helicopter sound (for Bell 214 type) being audible in air for four minutes before it passed over receivers, but only detectable underwater for 38 seconds at 3 m depth and for 11 seconds at 18 m depth for the same flight path. Thus, the predicted extent of impact is between 3 to 18 m for a period of 11 – 38 seconds twice a day (landing and take-off).

No impacts to southern right whales within the reproduction BIA are predicted as the Thylacine platform is >65 km from the BIA. Based on the short-term, intermittent sounds a helicopter will make, the consequence to whales (including pygmy blue whales within the foraging BIA, southern right whales within the migration BIA and fin or sei whales which may also be foraging) and other marine fauna is assessed as Minor (1).

Subsea infrastructure

Measurements of operational wellheads (McCauley, 2002) showed sound levels of 113 dB re 1 µPa; with broadband sound level only marginally above rough sea condition ambient levels. Based on the measurements of wellhead sound discussed in McCauley (2002), which included flow in flowlines, sound produced along a flowline or pipeline may be expected to be similar to that described for wellheads, with the radiated sound field falling to ambient levels within a hundred metres of the flowline.

Woodside undertook acoustic measurements of underwater sound emissions generated by the operation of choke valves associated with the Angel facility (JASCO 2015; in Woodside, 2020). These measurements indicated choke valve sound is continuous, and the frequency and intensity of sound emitted is dependent on the rate of production from the well. Sound intensity at low production rates (16% and 30% choke positions) were approximately 154–155 dB re 1 µPa, with higher production rates (85% and 74% choke positions) resulting in lower sound levels (141–144 dB re 1 µPa). Sound emissions from choke valve operation was broadband in nature, with the majority of sound energy concentrated above 1 kHz. sound from choke valve operation was considered minor compared to sound generated by vessels using thrusters in the area.

Based on spherical spreading of underwater sound it is estimated that at the highest levels recorded of 155 dB re 1 µPa this would attenuate to below the cetacean behavioural sound criteria of 120 dB re 1 µPa within ~ 60 m. Based on this small distance the consequence to whales (including pygmy blue whales within the foraging BIA, southern right whales within the migration and reproduction BIAs and fin or sei whales which may also be foraging) and other marine fauna is assessed as Minor (1).

Rock bolt installation and subsea cutting

Subsea tree top plate trimming with a disk cutter may be required for any choke valve replacement work and would take ~1- 2 hours. Pangerc et al. (2016) described the underwater sound measurement data during an underwater diamond wire cutting of a 32" conductor (10 m above seabed in ~80 m depth) and found that at lower frequencies, the operation was generally indistinguishable above the background noise of the vessel. Acoustic modelling undertaken by JASCO (Koessler and McPherson 2021 Appendix C) modelled a stationary vessel at Thylacine North-1 on DP (operating at 20% MCR) plus a stationary vessel on DP (operating at 20% MCR) using a ROV cutting tool at Geographe-4. This showed an increase of ~30 m for the behaviour exposure criteria compared to an installation vessel on DP and ~6 m for the TTS 24 h exposure criteria. The furthest distance to either criteria is 2.98 km. As detailed in Figure 16, Figure 17, Figure 54 and Figure 55 in Koessler and McPherson (2021) (Appendix C) show that the ranges to the behaviour and TTS 24hr exposure criteria at Geographe for the vessel with the cutting tool are not influenced by the vessel at Thylacine North-1.

Information on sound levels from rock bolt installation was not available. Rock bolts are installed by hand equipment used by divers and could be presumed to be of a similar noise level to an ROV undertaking cutting as discussed above.

Vessels

Underwater sound emissions will be generated by vessel dynamic position (DP), and to a lesser extent machinery, pumps, and generators on vessels (Erbe et al. 2013).

6.5.4.1 Underwater sound level modelling

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with the Beach Energy Otway Development (Koessler and McPherson 2021 Appendix C), to supplement drilling and construction results previously presented in Koessler et al. (2020), Matthews et al. (2020) and Matthews et al. (2021). The results from these previous modelling studies have been revised due to a better understanding of the propagation loss in the region gained through the validation monitoring of drilling operations at Artisan-1 (McPherson et al. 2021).

The considered locations: Artisan and Thylacine were selected to estimate sound levels that would be representative of all locations within the Otway operations (at wells and along pipeline and umbilical routes) based on water depth, proximity to the continental slope, and the seabed type. Distances to sound level thresholds for vessel activities occurring close to shore, where the water depth is significantly less and decreases rapidly, are expected to be shorter than those modelled at Artisan. This is in part because of the increased losses due to the increased number of surface and seafloor interactions the sound field experiences in shallow water, but also due to the lower frequencies where the sources are louder being less supported in significantly shallow water.

The modelling study assessed distances from activities where underwater sound levels reached exposure criteria corresponding to various levels of potential impact to marine fauna. The marine fauna considered was based on a review of receptors that may be impacted by continuous sound, these were marine mammals, turtles, and fish. The exposure criteria selected for the modelling and the impact assessment were selected as they have been accepted by regulatory agencies and because they represent current best available science (Koessler et al. 2020, Matthews et al. (2020).

Where several modelled scenarios are representative of vessel activities, such as where location or season has been varied in the modelling parameters, the furthest distance to the exposure criteria has been selected for evaluation of potential impacts.

Table 21 summarised the modelling scenarios applicable to Otway Offshore Operations. As the sound pressure level (SPL) metric does not depend on the duration of the operation, these estimates are valid for both, stationary (maintenance and repair) and moving (inspection) vessel activities.

Table 21 Modelled underwater sound scenarios

#	Activity	Modelled Scenario
A4	Platform	Platform operations
A3	OSV standby transit	Offshore support vessel on standby using minimal DP
1, 2 ,3, 4	Platform and OSV resupply	Resupply of the platform can take between 2 to 8 hr depending on the activity being undertaken. Modelling based on the Siem Offshore VS491 vessel which are currently being used for supply vessel for the Otway Offshore Operations.
5, 6	Platform and OSV standby	Standoff from platform during higher risk activities such as work over, heavy lifts and well intervention. OSV standing by within 1–3 km of the platform for up to 8 hr while work on the platform is undertaken. The vessel is required to be ready to respond as required. During this time, the vessel is assumed to be operating under a mix of slow transit, minimal power DP and drifting. This modelling was based on the Siem Offshore VS491 which are currently being used for supply vessel for the Otway Offshore Operations.
7, 8	Maintenance and Repair - Thylacine	Stationary vessel on DP undertaking repair / maintenance. Pipelay Vessel (PLV) stationary on location, operating at 20% MCR (i.e. DP) This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake maintenance and repair activities.
11, 12	Maintenance and Repair stationary - Artisan	
9, 10	Inspection vessel moving- Thylacine	Slowly moving vessel undertaking inspection of subsea infrastructure. Pipelay Vessel (PLV) moving slowly, operating at 20% MCR This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake inspection activities.
13, 14	Inspection vessel moving - Artisan	
15,16	Maintenance and Repair stationary at Thylacine with Maintenance and Repair stationary at Geographe with ROV cutting tool	Stationary vessel on DP undertaking repair / maintenance. Pipelay Vessel (PLV) stationary on location, operating at 20% MCR (i.e. DP) with ROV cutting tool. This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake maintenance and repair activities.

6.5.4.2 Marine Mammals

Exposure Criteria - PTS and TTS

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

The NFMS (2018) exposure criteria are based on a cumulative SELs over a period of 24 h. Table 22 details the criteria and furthest modelled distances to them for each scenario.

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

Exposure Criteria - Behaviour

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. The current interim NFMS (NOAA 2019) criterion of 120 dB re 1 µPa for non-impulsive sound sources such as vessels is used as the marine mammal behavioural criteria for this assessment as it represents a conservative criterion as Southall et al. (2007) reviewed extensive literature and studies in relation to marine mammal behavioural response to impulsive (seismic, pile driving) and non-impulsive (drilling, vessels) and found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa.

Table 22 details the furthest modelled distance to the NOAA (2019) exposure criteria for each scenario.

Phocid seals

For Phocid seals the furthest distance to the PTS criteria is reached at 80 m and the furthest distance to the TTS criteria is 430 m during resupply at the platform. From the PMST Reports Phocid seals were not identified within the operational area (500 m around the operations infrastructure) and thus PTS and TTS are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. No Phocid seals were identified within the Sound Behaviour EMBA (7.5 km) PMST report (Appendix A.5) thus behaviour impacts are not assessed further.

Otariid seals

For Otariid seal the PTS criteria is only reached at 10 m for the maintenance and repair activities while cutting and the furthest distance to the TTS criteria is 80 m during resupply at the platform. The Australian and New Zealand fur seal may occur within the operational area (500 m around the operations infrastructure) but no biologically important behaviours or biologically important areas were identified within the operational area thus PTS and TTS are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified that the Australian and New Zealand fur seal may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours, biologically important areas, aggregation areas or haul-out area identified within the predicted ensonified area.

High-frequency cetaceans

The furthest distance to the high-frequency cetacean PTS criteria is 110 m and the TTS criteria is 1.46 km. The PMST Report (Appendix A.4 Sound 24 hr EMBA 1.5 km) identified that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound 24 hr EMBA (1.5 km), however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified that that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours or biologically important areas identified within the predicted ensonified area.

Mid-frequency cetaceans

The furthest distance to the mid-frequency cetacean PTS criteria is 50 m and the TTS criteria is 100 m. The PMST Report (Appendix A.4 Sound 24 hr EMBA 1.5 km) identified several dolphin species, beaked and toothed whales, however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified several dolphin species, beaked and toothed whales that may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours or biologically important areas identified within the predicted ensonified area.

Table 22: Cetacean PTS, TTS and behaviour sound criteria and predicted furthest distances and areas

Hearing group	SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	OSV standby transit		Platform		Platform and OSV resupply		Platform and OSV standby		Inspection vessel moving		Maintenance and repair vessel stationary		Maintenance and repair vessel stationary with ROV cutting tool	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS															
LF cetaceans	199	–	–	0.02	0.001	0.18	0.07	0.02	0.001	0.02	0.21	0.06	0.01	0.06	0.01
MF cetaceans	198	–	–	0.02	0.001	0.05	0.002	0.02	0.001	0.01	0.02	0.02	0.001	0.02	0.001
HF cetaceans	173	–	–	0.03	0.004	0.11	0.02	0.03	0.004	0.03	0.37	0.09	0.03	0.12	0.04
Phocid seals	201	–	–	0.02	0.001	0.08	0.01	0.02	0.001	0.01	0.14	0.02	0.001	0.02	0.001
Otariid seals	219	–	–	–	–	–	–	–	–	–	–	–	–	0.01	0.001
TTS															
LF cetaceans	179	–	–	0.04	0.004	1.25	4.01	0.04	0.004	1.18	13.62	0.60	1.04	0.66	1.35
MF cetaceans	178	–	–	0.03	0.003	0.10	0.02	0.03	0.003	0.02	0.22	0.07	0.02	0.09	0.03
HF cetaceans	153	–	–	0.30	0.28	0.63	1.17	0.30	0.28	1.46	16.02	0.84	2.02	0.87	2.37
Phocid seals	181	–	–	0.03	0.00	0.43	0.46	0.03	0.00	0.13	1.54	0.19	0.02	0.19	0.12
Otariid seals	199	–	–	0.02	0.001	0.08	0.01	0.02	0.001	0.01	0.15	0.02	0.001	0.02	0.001
Behaviour		**SPL threshold** (Lp; dB re 1 µPa)													
Marine mammals	120	0.38		0.20		7.31		0.45		2.71		2.71		2.98	

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

Low-frequency cetaceans

The furthest distance to the low-frequency cetacean PTS criteria is 180 m and the TTS criteria is 1.25 km. Table 23 details the low-frequency cetaceans that have biologically important areas and/or biologically important behaviours within the Sound 24 hr EMBA (1.5 km).

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. Table 23 details the low-frequency cetaceans that have biologically important areas or biologically important behaviour within the Sound Behaviour EMBA (7.5 km).

The distance, area of impact and predicted duration for each activity is shown in Table 24.

Table 23: Low-frequency cetaceans with biologically important behaviours within the PTS and TTS ensonification area

Species	Biologically Important Behaviour
Blue whale	Foraging, feeding or related behaviour known to occur within area.
	High density foraging BIA
Fin whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs
Pygmy right whale	Foraging, feeding or related behaviour may to occur within area.
	No BIAs
Sei whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs
Southern right whale	Migration and reproduction BIAs

Table 24: Distance to sound criteria, area of impact and predicted duration for each activity

Activity	Furthest distance to sound criteria	Area of ensonification	Duration
Thylacine-A Wellhead Platform	40 m	0.004 km^2	Continuous
Thylacine-A Wellhead Platform resupply	7.31 km	167.87 km^2	Up to 6 hours for 2 days four times a year
Thylacine-A Wellhead Platform and vessel on standby	450 m	0.64 km^2	Up to 6 hours once or twice a year
Inspection vessel moving	2.71 km	23.07 km^2	Once a year for up to 30 days
Maintenance and repair vessel	2.71 km	23.07 km^2	Once every 2 years up to 30 days
Maintenance and repair vessel with ROV cutting tool or rock bolt installation	2.98 km	27.9 km^2	One off activities. Cutting ~ 1- 2 hrs Rock bolt up to 4 hrs

Blue whales

Foraging behaviour for blue whales has been identified in the area where the PTS, TTS and behavioural criteria is reached. Cetacean foraging within the Otway shelf, and hence the area where the PTS, TTS

and behavioural criteria is reached, is typically from January to April though whales maybe present from November to June which overlaps the period when Otway Offshore Operations activities may occur (activities occur year round).

The Conservation Management Plan for the Blue Whale (DoE, 2015b) details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area.

DAWE (2021a) defines 'displaced as a foraging area' as:

The recovery plan requirement, Action A.2.3, applies in relation to BIAs. A whale could be displaced from a Foraging Area if impact mitigation is not implemented. This means that underwater anthropogenic noise should not:

- *Stop or prevent any blue whale from foraging*
- *Cause any blue whale to move on when foraging*
- *Stop or prevent any blue whale from entering a Foraging Area*

It is considered that a whale is displaced from a Foraging Area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that Foraging Area. Mitigation measures must be implemented to reduce the risk of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur.

DAWE (2021a) defines 'injury to blue whales' as:

For the purpose of interpreting and applying Action Area A.2 of the Blue Whale CMP, injury is both permanent and temporary hearing impairment (Permanent Threshold Shift and Temporary Threshold Shift) and any other form of physical harm arising from anthropogenic sources of underwater noise.

As detailed in

Table 24 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- A conservative approach has been taken in applying the sound modelling and results such as the furthest distance to the PTS and TTS criteria for the scenarios modelled to assess potential impacts.
- The Conservation Management Plan for the Blue Whale (DoE, 2015b) details that shipping and industrial noise are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.
- The Conservation Management Plan for the Blue Whale (DoE, 2015b) details that "It is the high intensity signals with high peak pressures received at very short range that can cause acute impacts such as injury and death." As vessel noise is continuous noise sources and do not have high intensity signals it is unlikely that they would cause injury to foraging pygmy blue whales.

- Though activities may occur during the period when pygmy blue whales are likely to be foraging within the BIA, the largest area of potential impact within the pygmy blue whale high density foraging BIA (35,627 km^2) is very small, at any one time being:
    - ~0.00001% for the Thylacine-A Wellhead Platform continuous operations.
    - ~0.47% for up to 8 hours for resupply of the Thylacine-A Wellhead Platform.
    - ~0.002% for up to 8 hours for vessel standby at the Thylacine-A Wellhead Platform.
    - ~0.065% for up to 30 days for inspection, maintenance and repair activities.
- PTS and TTS impacts are not predicted from the Thylacine-A Wellhead Platform and or the Thylacine-A Wellhead Platform and vessel on standby based on predicted distance to the 24 hr exposure criteria are 20 m and 40 m respectively. It would be highly unlikely for a pygmy blue whale to remain within those distances for 24 hours.
- Displacement of foraging blue whales at the Thylacine-A Wellhead Platform are not predicted as the platform has been operating since 2006.
- For platform resupply, vessel on standby and inspection, maintenance and repair activities adopted controls as detailed in Section 6.5.5 will prevent possible PTS, TTS and displacement impacts to pygmy blue whale that may be foraging.

Southern right whales

For southern right whales the following areas are within the predicted ensonified area as shown in Figure 14:

- Migration BIA is within the area where the PTS, TTS and behavioural criteria is reached for all activities.
- Coastal reproduction BIA is within the area where the PTS, TTS and behavioural criteria is reached for inspection, maintenance, and repair activities.

There is the potential for southern right whales to be within the coastal reproduction BIAs May – September and transiting through the migration BIA April - October (DCCEEW 2023b).

As detailed in Table 24 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- A conservative approach has been taken in applying the sound modelling and results such as the furthest distance to the PTS and TTS criteria for the scenarios modelled to assess potential impacts.
- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.

- The draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identifies vessel noise as a minor consequence which is defined as individuals are affected but no affect at a population level.

- PTS and TTS impacts are not predicted from any of the activities to southern right whales, by themselves or with calf, that may be moving through the migration BIA to and from the coastal reproduction BIA based on mean recorded swims speeds for southern right whales are between 3 – 3.3 km/hr (Mate et al. 2011; Mackay et al. 2015 cited in Charlton 2017). As the furthest distance to the PTS or TTS criteria is 1.25 km over 8 hr and 750 m over 2 hr, southern right whales, by themselves or with calf, would move out of the ensonified area before PTS or TTS could occur.

- Avoidance behaviour may be exhibited if southern right whales are within the area where the behavioural criteria is reached. Disturbance on the behaviour of the mothers that could increase their energy expenditure will result in a reduction of energy available for their calf and for their return migration (Christiansen et al. 2014b). Based on an average swim speed of 3 km/hr (Charlton 2021 per com) energetic costs would be extremely low if avoidance behaviour occurred for the platform (200 m), the only continuous activity, and vessel standby (450 m), and low for platform resupply (7.31 km) and inspection, maintenance and repair activities (2.27 – 2.98 km) and thus not predicted to impact the fitness of mothers or calves moving between calving and feeding areas.

- Southern right whales may avoid the area where the behavioural criteria is reached but there is no impediment to them continuing to and from the coastal reproduction BIA. Southern right whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (DSEWPaC 2012a). Along the Australian coast, individual southern right whales use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (DSEWPaC 2012a). As such, avoidance of the ensonified area is unlikely to prevent or hinder them from undertaking their seasonal migrations.

- PTS, TTS or behavioural criteria from activities at the platform, including vessel standby and resupply, are not reached at the coastal reproduction BIA.

- For inspection, maintenance and repair activities adopted controls as detailed in Section 6.5.5 will prevent possible PTS, TTS and displacement impacts to southern right whales that maybe present in the reproduction BIA. This includes CM#13b - SRW Exclusion Zone where no IMR activities will be planned within 3 km of the reproduction BIA during May to end of September when southern right whales are potentially present in the BIA.

- For platform resupply, vessel on standby and inspection, maintenance and repair activities within the southern right whale migration BIA adopted controls as detailed in Section 6.5.5 will prevent possible PTS, TTS and displacement impacts to migrating southern right whales.

- Cumulative impacts from the activities proposed within this EP at the Thylacine-A Wellhead Platform, such as vessel standby and resupply, and from IMR activities, are not predicted at the southern right whales reproduction BIA based on:

    - IMR activities will not be undertaken within 3 km (furthest distance to noise criteria for IMR activities) of the southern right whale reproduction BIA when southern right whales are

potentially present in the BIA and noise criteria (PTS, TTS or behavioural) from activities at the platform, such as vessel standby and resupply, are not reached at the southern right whale reproduction BIA.

- The Thylacine-A Wellhead Platform is >65 km from the southern right whale reproduction BIA. Acoustic modelling (Koessler and McPherson 2021 Appendix C) for concurrent activities at the platform such as platform operations and resupply shows the furthest distance to the noise criteria (behaviour) is 7.31 km and for IMR activities is 2.98 km, thus if an IMR activity was to occur within 3 km of the platform the overlapping noise footprint would not be reached at the southern right whale reproduction BIA.
- Concurrent IMR campaigns are not planned.

- Cumulative impacts from the activities proposed within this EP at the Thylacine-A Wellhead Platform, such as vessel standby and resupply, and from IMR activities, are not predicted to southern right whales in the migration BIA as they will be moving through the area and the controls as detailed in Section 6.5.5 will prevent possible PTS, TTS, and displacement impacts.
- Cumulative impacts from activities within the surrounding area on southern right whales are not predicted based on:
  - Beach Otway Development Drilling is complete.
  - Beach Geographe and Thylacine subsea installation and commissioning is complete.
  - Cooper Energy CHN Operations will also undertake IMR activities on their offshore infrastructure which is to the west of the Beach Otway Operations infrastructure. Beach will not be undertaking IMR activities within 3 km of the southern right whale reproduction BIA when southern right whales are potentially present in the BIA, thus the closest distance to Cooper Energy's infrastructure and to Beach's infrastructure outside this 3 km area is 3 km. As Cooper Energy CHN Operations EP does not include acoustic modelling and the IMR activities are within the same area and likely to use similar vessels it can be presumed the furthest distance to the noise criteria (behaviour) of 2.98 km would also apply to Cooper Energy's IMR activities. Thus, if IMR activities where being undertaken by Beach and Cooper Energy at the same time impacts from these concurrent activities are not predicted to the southern right whale BIA.

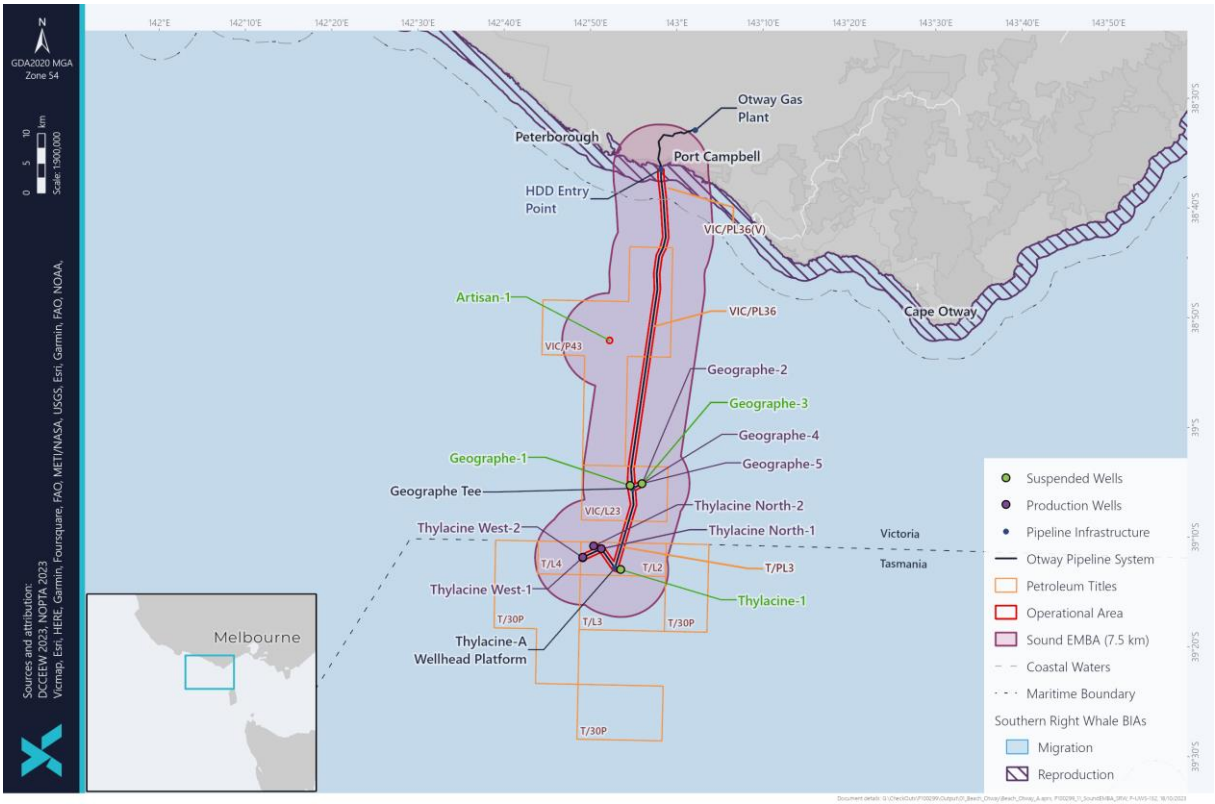

Figure 14: Southern Right Whale Reproduction and Migration BIAs and Sound EMBA

Other whales

Foraging behaviour for fin, pygmy right and sei whales has been identified in the area where the PTS, TTS and behavioural criteria is reached. Cetacean foraging within the Otway shelf, and hence the area where the PTS, TTS and behavioural criteria is reached, is typically from January to April though whales maybe present from November to June which overlaps the period when Otway Offshore Operations activities may occur (activities occur year round).

The fin, pygmy right and sei whales do not have conservation management plans. The fin and sei whales have conservation advice (TSSC, 2015f; TSSC, 2016g) which both identify anthropogenic noise as a threat with the conservation and management actions of:

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

As detailed in Table 24 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- The fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.

- There is no conservation advice for the pygmy right whale and the Species Profile and Threats Database (DoE 2023p) does not identify anthropogenic noise and acoustic disturbance as a threat.
- Low numbers of fin, sei and pygmy right whales are predicted within the PTS, TTS and behaviour ensonification area based on the following:
    - the PTS and TTS ensonification area is ~75 km from the Bonney coast upwelling KEF which is known as feeding aggregation area (Gill et al. 2011; McCauley et al. 2018).
    - the PTS and TTS ensonification area is within an area with a historical frequency <10% of an upwelling occurring (Huang and Wang 2019).
    - no biologically important areas were identified for these species.
    - aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of 8 individuals, 12 sei whale sightings consisting of 14 individuals and one pygmy right whale sighting consisting of 100 individuals (Gill et al. 2015). Gill et al. (2015) did observer feeding behaviour for sei and fin whales but noted that it is at least an opportunistic feeding area for these species.

6.5.4.3 Marine Turtles

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

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to develop sound exposure criteria for fish and turtles. The Working Group developed guidelines with specific thresholds for different levels of effects for several species groups including turtles .

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

Popper et al. (2014) found that there was insufficient data available to propose a quantitative exposure guideline or criteria for marine turtles for continuous sound such as those generated by vessels and instead suggested general distances to assess potential impacts. Using semi-quantitative analysis, Popper et al. (2014) suggests that there is a low risk to marine turtles from shipping and continuous sound except for TTS near (10s of metres) to the sound source, and masking at near, intermediate (hundreds of metres) and far (thousands of metres) distances and behaviour at near and intermediate distances from the sound source. Based on this information avoidance behaviour may occur within the operational area.

Finneran et al. (2017) presented revised thresholds for turtle PTS and TTS for continuous sound. Table 25 details the criteria and modelled distances to them (Koessler and McPherson 2021. Appendix C). The 24 hr PTS criteria was reached within 40 m when undertaking resupply at the Thylacine-A Wellhead Platform and 20 m when the undertaking maintenance and repair activities. The 24 hr TTS criteria was reached within:

- 20 m of the Thylacine-A Wellhead Platform with and without the support vessel on standby.

- 170 m when undertaking resupply at the Thylacine-A Wellhead Platform.
- 30 m when undertaking inspection activities.
- 80 m when undertaking maintenance and repair activities.

Three marine turtle species may occur within the operational area (500 m) though no BIAs or habitat critical to the survival of the species were identified.

The extent of the area of impact is predicted to be within the operational area. The severity is assessed as Minor (1) based on:

- The Recovery Plan for Marine Turtles in Australia (CoA, 2017b) details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat and no marine turtle important habits are located within the area that maybe impacted.
- Thresholds for turtle PTS and TTS over 24 hrs were predicted to occur with a maximum distance of 170 m within the operational area where no marine turtle important habits are located.
- Avoidance behaviour may occur within the operational area where no marine turtle important habits are located.
- low numbers of marine turtles are predicted in the operational area and therefore impacts would be limited to a small number of individuals.

6.5.4.4 Fish

Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to fish from ship sound emissions. Popper et al., (2014) details that risks of mortality and potential mortal injury, and recoverable injury impacts to fish with no swim bladder (sharks) or where the swim bladder is not involved in hearing is low and that TTS in hearing may be a moderate risk near (tens of metres) the vessel. For fish with a swim bladder involved in hearing risks of mortality and potential mortal injury impacts is low. However, some evidence suggests that fish sensitive to acoustic pressure show a recoverable loss in hearing sensitivity, or injury when exposed to high levels of sound and Popper et al. (2014) details SPL criteria for fish with a swim bladder involved in hearing. Table 26 details the criteria and modelled distances to them (Koessler and McPherson 2021. Appendix C).

No cumulative impacts are expected as there are no habitats likely to support site-attached fish in the operational area.

The recoverable injury threshold was not reached for any scenario. The 12 hr TTS criteria was reached within 140 m when undertaking resupply at the Thylacine-A Wellhead Platform and 30 m when the undertaking IMR activities and 40 m when undertaking maintenance and repair activities with cutting or rock bolting. As there are no habitats likely to support site-attached fish in the operational area it is also unlikely that fish species would be present for a period of 12 hours. Thus, TTS impacts are not predicted.

Behavioural impacts are more likely such as moving away from the vessel. There are no habitats or features within the operational area that would restrict fish and sharks from moving away from the vessel.

The operational area is within a distribution BIA for the white shark though no habitat critical to the survival of the species or behaviours were identified. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify sound as a threat.

Low levels of commercial fishing for fish species were identified within the operational area within shark fishing occurring nearshore and snapper and wrasse fishing within grids covering Artisan and the Otway Pipeline System. Thus, temporary avoidance may occur during inspection, maintenance and repair activities.

The extent of the area of impact is predicted to be within the operational area for the duration of vessel activities. The severity is assessed as Minor (1) based on:

- The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify sound impacts as a threat.
- Avoidance behaviour may occur within the operational area, however, no habitats likely to support site-attached fish have been identified within the operational area.
- Temporary avoidance behaviour may occur within the operational area (500 m) for commercial fish during inspection, maintenance and repair activities, however recovery would occur once the activity had finished. Based on the small area of impact, low fishing activity and that displaced fish would still being available to be caught outside of the operational area, impacts to commercial fishing are not predicted.

Table 25: Finneran Turtle SEL_{24h} Thresholds and Modelled Distances

Marine Turtles	SEL_{24h} threshold	Platform (Scenario A4)	OSV standby (Scenario A3)	Platform and OSV standby (Scenario 5 & 6)	Platform resupply (Scenario 1, 2,3 ,4)	Vessel based inspection (DP) (Scenario 9, 10, 13, 14)	Vessel based maintenance / repair with and without cutting (Scenario 7, 8, 11, 12, 15, 16)
		R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)
PTS	220 dB re 1 $\mu Pa^2 \cdot s$	Not reached	Not reached	Not reached	40 m	Not reached	20 m
TTS	200 dB re 1 $\mu Pa^2 \cdot s$	20 m	Not reached	20 m	170 m	30 m	80 m

Table 26: SPL Criteria for Fish with a Swim Bladder involved in Hearing and Modelled Distances

Fish: Swim bladder involved in hearing	SPL (Lp; dB re 1 µPa)	Platform (Scenario A4)	OSV standby (Scenario A3)	Platform and OSV standby (Scenario 5)	Platform resupply (Scenario 1)	Vessel based Inspection/ maintenance / repair (Scenario 7, 8, 9,10)	Vessel based maintenance / repair with cutting (Scenario 15, 16)
		Rmax (km)	Rmax (km)	Rmax (km)	Rmax (km)	Rmax (km)	Rmax (km)
Recoverable injury	170 dB SPL for 48 h	Not reached	Not reached	Not reached	Not reached	Not reached	Not reached
TTS	158 dB SPL for 12 h	Not reached	Not reached	Not reached	140 m	30 m	40 m

6.5.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Underwater sound emissions	
ALARP decision context and justification	ALARP Decision Context: Type B Impacts from sound emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans Wildlife (Marine Mammal) Regulations 2009	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans and the Vic Wildlife (Marine Mammal) Regulations 2009 describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels and helicopters. Support vessels will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 and Vic Wildlife (Marine Mammal) Regulations 2009 in relation to distances to cetaceans. These regulations stipulate a safe operating distance of 300 m. This will be increased to 500 m to take into account the furthest distance to the sound criteria (450 m) when the support vessel is on standby. Helicopters will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans. The Wildlife (Marine Mammal) Regulations 2009 only provides separation distances to seals on land and at protected or significant seal breeding colonies, none of these are within the area of predicted impact for seals.
CM#13: Otway Operations Vessel Whale Management Procedure	The Vessel Whale Management Procedure details the controls to prevent possible PTS, TTS and displacement impacts to foraging blue whale and southern right whales that maybe present in the migration and reproduction BIAs. The procedure assumes that once an activity is underway foraging whales that enter the pre-activity survey zone are not displaced as foraging behaviour has not been disrupted as the whale has commenced or continued foraging and thus aligns with the Conservation Management Plan for the Blue Whale (DoE, 2015b) and DAWE (2021a) definitions. In this situation only PTS and TTS need to be managed to ensure the activity is not inconsistent with the Conservation Management Plan for the Blue Whale (DoE, 2015b). Prior to an activity commencing a pre-activity survey will be undertaken of the activity survey zone for the activity: • Resupply – 7.5 km • Inspection – 3 km • Maintenance and repair – 3 km The activity survey zones are based on the distance to the furthest modelled PTS, TTS or behaviour criteria, as detailed in Table 22, and have been rounded up to take into account accuracy of estimation of distance at sea. On advice from the Blue Whale Study, a conservative approach will be adopted whereby it is assumed that all whales present on the Otway shelf are conducting biologically important behaviours (e.g., foraging blue whales). All whales will also include southern right whales with or without a calf. Surveys will be undertaken for 30 min prior to the activity commencing. If a whale is sighted within the pre-activity survey zone the activity will not commence until: • No whales are observed for 30 min within the pre-activity survey zone; or

- Whales are observed leaving the pre-activity survey zone.

MMOs currently contracted to the Otway drilling campaign have stated that from a vessel bridge height of ~20 m, observations are possible up to 7 km. Given that the vessels used for the drilling campaign are the same vessels that will be used to support operations and undertake resupply, the pre-activity survey zone distance of 7.5 km can be met as the vessel will be able to move around within the pre-activity survey zone providing full observation coverage prior to resupply commencing.

The period of 30 min is deemed as sufficient time to observed deep diving whales such as blue whales based on blue whale foraging behaviour and dive duration.

Once the activity has commenced observations will be undertaken within the activity survey zone distances detailed above.

If a whale is sighted within the activity survey zone the following will occur:

- If the vessel can do so it will move away from the whale and maintain a minimum separation distance equal to the activity survey zone.
- If the vessel cannot move away from the whale, the vessel will reduce thrusters if safe to do so. The activity will cease as soon as it is safe, and the vessel will move out of the activity survey zone.

The activity can recommence once:

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

As detailed platform resupply is undertaken using the drilling support vessels from which MMOs can observe up to 7 km. Thus, once resupply commences, they may not be able to see as far as the 7.5 km activity survey zone. As resupply activities at the Thylacine-A Wellhead Platform may take up to 8 hrs and are undertaken ~5 times a year the cost, both monetary and increased sound emissions, associated with having another vessel present to be able to see the full activity survey zone is disproportionate to the benefit as the presurvey of the activity zone will be undertaken to identify if any whales are within the activity zone or likely to enter the activity zone. The probability that pygmy blue whales would enter the activity zone to forage within the period that resupply would be undertaken would be extremely low considering the short resupply time.

Activities can commence at night or in low visibility conditions (i.e., when observations cannot be undertaken) if no more than three whales have been seen in the activity survey zone in the preceding daylight hours. The no more than three whales criterion is acceptable for blue whales because it indicates the krill stock at the location has been diminished. More than three whales within the previous daylight hours may indicate a large krill supply and more whales could be expected. The daylight hours is justified because it is the longest possible continuous observation period (i.e., one full day of observations). Three southern right whales would be an indication that there is an increased likelihood of a southern right whale within the activity survey zone during the period that observations cannot be undertaken.

During the period that drilling is occurring for the Otway Development the following will be undertaken to inform operations activities in relation to the presence of whales within the Otway Development and Operations areas:

One week prior to an activity being undertaken a review of whale data to determine if blue and/or southern right whales have been observed in the area.

When undertaking an activity presence of whales observed from drilling or operations activities will be communicated via radio.

CM#13a Marine mammal observer	A trained and experienced MMO will undertake activity survey zone observations for activities that will be undertaken over a period greater than 24 hours, this will typically be for IMR activities. For IMR activities greater than 5 consecutive days at sea an additional trained MMO will be onboard the vessel to support the trained and experienced MMO. Five consecutive days at sea was deemed appropriate to managed fatigue during periods when there are longer daylight hours in southern Australia during the summer months (up to 15 hours) which are greater than a 12-hr work shift. For a period of up to 5 consecutive days fatigue can be appropriately managed by the MMO being supported by the Officer of the Watch as per below. In addition, vessel crew who act as Officer of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO during daylight hours. Resupply activities at the Thylacine-A Wellhead Platform may take up to 8 hrs and are undertaken ~5 times a year. For resupply the vessel Officer of the Watch will undertake the activity survey zone observations. They will be trained in the Vessel Whale Management Procedure, whale observation and distance estimation. This is deemed acceptable based on: • Mitigation actions are based on sighting a whale within the activity survey zone, so identification of species and/or activity is not required and thus experience in whale identification is not required. • The vessel Officer of the Watch will be experience at distance estimation at sea as their role is to monitor for hazards at sea in all conditions. • The cost is disproportionate as there is no increase in environmental benefit as the Officer of the Watch is capable of undertaking the observations required for an activity that will take at most 8 hours.
CM#13b SRW Exclusion Zone	No IMR activities will be planned within 3 km of the reproduction BIA during May to end of September when southern right whales are potentially present in the BIA. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) includes objectives relevant for evaluation of environmental impacts of underwater noise on southern right whales and requires that 'aggregations categorised as emerging areas in 2011 meet criteria for an established area by 2021; OR are occupied in a greater number of years from 2011–2021 compared with 2005–2010'. The implementation of an exclusion zone for the reproduction BIA, which has been updated (NCVA 2023) and includes emerging aggregation areas, will ensure that the activity is not inconsistent with the in force Conservation Management Plan for the Southern Right Whale as it will not impede the recovery objective for emerging aggregation areas. This control also ensures that the activity is not inconsistent with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) that details that actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance.
CM#4: Preventative Maintenance System	Power generation and propulsion systems on the vessels will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.

Additional controls assessed		
Control	**Cost/Benefit Analysis**	**Control Implemented?**
Seasonal timing	Pygmy blue whales are potentially in the foraging BIA within the Otway shelf waters from November through to June. Southern right whales may travel through the migration BIA, which the operational area overlaps, to and from the coastal reproduction BIA during April – October and be present in the coastal reproduction BIA, which the operational area overlaps, between May – September (DCCEEW 2023b). Thus, there is no period when there is not a whale undertaking a biologically important behaviour within the Otway region. The implementation of additional controls above the legislative requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans will be implemented to manage potential impacts to whales undertaking biologically important behaviour.	No
Anchoring of the vessels	This control is not feasible for the vessels to support operations and for IMR activities based on: Inspection activities require the vessel to be continuously moving while undertaking the inspection. Maintenance and repair activities require minor adjustments to the vessel position while undertaking the activity and anchoring may damage existing subsea infrastructure. Resupply operations require the vessel to use DP to maintain position adjacent to the platform to counter wind and current conditions. Vessel standby activities require the vessel to be able to react immediately in the event of an issue on the platform.	No
Shut down zones	Implemented with safety controls. Shutting down the CSV DP system during installation activities could lead to the vessel drifting and colliding with another vessel, potentially resulting in a safety risk to personnel or an MDO spill. It may lead to damage to subsea equipment if the equipment is suspended by a crane in the air or in the water at the time of shutdown or, as a worst case, result in damage to existing subsea equipment. It could also result in a vessel strike to the whales that shutting down the propulsion system is meant to protect.	No
Passive acoustic monitoring (PAM)	PAM is most useful in the detection of odontocetes such as sperm whales, dolphins and porpoise known to emit regular distinctive clicks and high frequency calls during long dives. PAM has limited utility in detecting lower frequency calls of baleen whales (such as blue whales, southern right whales) especially when in the presence of constant background low frequency sound such as that generated by the vessel towing the PAM system. Given the	No

	very low utility and associated unreliability of using PAM to inform mitigation decision making, any additional cost is considered disproportionate to the benefit gained.	
Dedicated monitoring vessel	An additional dedicated vessel is not required as monitoring activities can be effectively conducted from the Thylacine-A Wellhead Platform and/or operations or IMR vessels. Cost is disproportionate to marginal environmental benefit.	No
Aerial surveillance	Aerial surveillance from aircraft or drones is not required as monitoring activities can be effectively conducted from the Thylacine-A Wellhead Platform and/or operations or IMR vessels. Cost is disproportionate to marginal environmental benefit.	No
Consequence rating	Moderate (2)	
Likelihood of occurrence	NA	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	Sound emissions were assessed as having a moderate consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.	
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.	
External context	There have been no stakeholder objections or claims regarding sound emissions.	
Other requirements	Sound emissions will be managed in accordance with legislative requirements. Sound emissions will: • Not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (CoA, 2017b). • Be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area (DoE, 2015a). • Not impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). • Not impact southern right whale migration and reproduction BIAs (DCCEEW, 2022a; DSEWPaC, 2012a). • Not impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC, 2013a). Actions from the Conservation Management Plan for the Blue Whale (DoE 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 6.5.4.2 assesses the effects of anthropogenic noise from the activity on blue whale behaviour.	

	• Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. Section 6.5.4.2 demonstrates that the activity can be conducted in a manner that is consistent with the conservation management plan and will not result in injury or displacement of pygmy blue whales from a foraging BIA. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Anthropogenic noise in biologically important areas will be managed such that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance. • Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to Southern Right Whales to the lowest possible level. Section 6.5.4.2 assesses the effects of anthropogenic noise from the activity on southern right whales and Section 6.5.5 includes consideration of national policy and guidelines relevant to vessels. • Quantify risks of anthropogenic underwater noise to Southern Right Whales, including behavioural disturbance, changes to vocalisations, and physiological effects to whales. Section 6.5.5 assesses the effects of anthropogenic noise from geophysical surveys on southern right whales.
Monitoring and reporting	Cetacean sightings records.
Acceptability outcome	**Acceptable**

6.6 Physical Presence

6.6.1 Hazards

Physical presence of the Otway Offshore Operations includes:

- Thylacine A-Platform, T-1 suspended well and associated PSZ (gazetted 2005)
- Geographe subsea wells and infrastructure and associated PSZ (gazetted 2013)
- Thylacine subsea wells and infrastructure and associated PSZ (gazetted 2022)
- Artisan-1 suspended well and associated PSZ (gazetted 2020)
- Otway Pipeline system
- 500 m safety zone around vessels when undertaking IMR activities and geophysical surveys.

6.6.2 Predicted Environmental Impacts

The physical presence of offshore infrastructure, PSZs and vessels operating within the operational area can result in the displacement of other marine users.

The physical presence of subsea infrastructure on the seabed can result in snagging of fishing equipment.

A new or increased environmental impact or risk could occur from the Thylacine subsea infrastructure that was not assessed as part of the accepted Otway Offshore Operations EP. This infrastructure was installed as part of the Thylacine Installation and Commissioning EP. This additional infrastructure includes flowlines, umbilicals and subsea manifolds.

6.6.3 EMBA

Predicted impacts from the physical presence of offshore infrastructure, PSZs and vessels will be limited to the operational area.

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

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

6.6.4 Consequence Evaluation

Recreation and Tourism

Recreation and tourism could be affected by restricted access to an area (i.e. due to the presence of a PSZ), particularly if the area is of interest due to fishing opportunities or presence of marine fauna. Impacts to recreational fishing and tourism are not predicted due to the distance that the PSZs are offshore (32 km - 70 km) and the absence of emergent features within the operational area. Vessel activities and the Otway Pipeline System which may intersect areas nearshore where recreational fishing occurs ongoing for over 10 years and to date there has been no interactions or incidents with recreation and tourism activities.

Commercial shipping

The operational area includes major shipping routes, however, the gazetted PSZs and vessel activities associated with the Otway Gas Development have been ongoing for over 10 years and to date there has been no interactions or incidents.

Commercial vessels are required to avoid the gazetted PSZs. PSZs are marked on navigation charts and communicated to marine users, allowing commercial vessels to plan their journey to ensure they are not inconvenienced by the 500 m exclusion area.

Vessels undertaking activities within the operational area will not be anchored, and any disturbance to commercial vessels will be minor disturbance only.

The extent of the area of impact is predicted to be the area of the gazetted PSZs. The severity is assessed as Minor (1) based on the area of impact is small and the exclusion is required for safe operations of the platform and commercial vessels.

Petroleum activities

Beach-managed petroleum activity may be undertaken within the operational area as part of the Otway Offshore Development, however there are no other petroleum activities managed by other titleholders planned within the operational area.

Petroleum activities managed by other titleholders will be required to avoid the permanent PSZs gazetted around the Thylacine-A Wellhead Platform, subsea infrastructure and Artisan-1 well. Displacement of other petroleum activities is therefore not predicted.

Commercial fishing

The Commonwealth SESSF and Southern Squid Jig Fishery have catch effort within the operational area.

Based on Victorian Fishing Association data from 2011 to 2021 the catch effort in the fishing grids surrounding the operational area is low, with a vast majority of the fishing effort congregated around the shoreline.

During stakeholder consultation for previous Beach activities up to six fishers have identified they may fish in the broader Otway Offshore Development area which includes the operational areas of the development wells.

A report commissioned by Beach and developed by South East Trawl Fishing Industry Association (SETFIA) on Trawl and Gillnet fishing activity (October 2019) found:

- Trawl fishing in the Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector board trawl sub-sector does not occur in the Otway Offshore Project area as the grounds appear too rough for trawl fishing in its current form.
- Gillnet fishing in the Southern and Eastern Scalefish and Shark Fishery Gillnet Hook and Trap Sector does not seem to occur within the Otway Offshore Project area.
- There is no Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Danish seine sub-sector fishing in the Otway Offshore Project area.

There is a clear separation of these commercial fishers and the Offshore Project area. Therefore, no interaction is anticipated between trawl or gill net fishers and the Otway Offshore Operations.

During stakeholder consultation for previous Beach activities stakeholders have raised concerns in relation to displacement of their fishing activities in relation to new PSZs. No comments were received in relation to displacement of fishers during stakeholder consultation undertaken for the revision of this EP. The gazetted PSZs and vessel activities associated with the Otway Gas Development have been ongoing for over 10 years and to date there has been no interactions or incidents. The most recent PSZ at Thylacine was communicated to commercial fishers with no concerns raised.

The extent of displacement is the gazetted PSZs. The severity is assessed as Minor (1) based on:

- Small area of displacement (0.79 km2) within each petroleum safety zone which have been in place since 2005 for the Thylacine-A Wellhead Platform, 2013 for the Geographe wells and subsea

infrastructure, 2022 for the Thylacine wells and subsea infrastructure and 2020 for the Artisan-1 well.

- Limited fishing has been identified within the operational area other than the nearshore area of the Otway Pipeline System and HDD Entry Point.

6.6.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Physical Presence	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from physical displacement are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. Though objections and claims have been raised by stakeholders, via consultation in relation to development activities in the Otway Development Area, in relation to trawl and gillnet snagging risks on subsea wells subsequent data identified that there is no trawl or gillnet fishing in the operational areas. Objections and claims have also been raised by stakeholders, via consultation in relation to development activities in the Otway Development Area, in relation to displacement of their fishing areas, however, these have been adequately assessed and controls adopted to manage impacts to ALARP. The infrastructure that connects the Thylacine wells to the Thylacine A platform is estimated to have an additional footprint of 6,000 m^2. This infrastructure was considered to be the minimal amount to ensure safe operations of the offshore facilities with no redundant or future equipment included in the scope. The additional footprint was reduced to ALARP to ensure safe operations. No objections or claims were raised from fishers from consultation undertaken for the development of this EP. As the impact consequence is rated as Minor (1) applying good industry practice, is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#14: Ongoing consultation	Consultation will continue with relevant stakeholders
CM#15: Permanent Petroleum Safety Zone (PSZ)	PSZs, administrated by NOPSEMA under the OPGGS Act, are specified areas surrounding petroleum wells, structures or equipment which vessels or classes of vessel are prohibited from entering or being present in. Otway Pipeline System, Thylacine-A Wellhead Platform and subsea infrastructure PSZs are clearly marked on navigational charts
CM#16: Beach Fair Ocean Access Procedure	Beach's Fair Ocean Access Procedure (Appendix D) was developed with input from commercial fishing industry organisations (Bass Strait Scallop Industry Association, Scallop Fisherman's Association of Tasmania, South East Trawl Fishing Industry Association and Tasmanian Seafood Industry Council. The procedure details the process whereby a commercial fisher can claim compensation for an economic loss associated with Beach's offshore activities where impacts cannot be avoided. An information sheet on the procedure is available in Appendix D.

CM#17: Navigation and communication aids	The Thylacine-A Wellhead Platform is provided with navigational lights, RACON and foghorn in accordance with International Association of Lighthouse Authorities (IALA) requirements.
CM#18: MO 30: Prevention of collisions	AMSA MO 30: Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.
CM#19: MO 27: Safety of navigation and radio equipment	AMSA MO 27: Safety of navigation and radio equipment gives effect to SOLAS regulations regarding radiocommunication and safety of navigation and provides for navigation safety measures and equipment and radio equipment requirements.
CM#2: Marking of Man-Made Offshore Structures	Thylacine-A Wellhead Platform: Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Physical displacement was assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
External context	The merits of claims or objections raised by a relevant stakeholder have been adequately assessed and additional controls adopted where appropriate. The additional footprint was discussed with Relevant Persons (see Section 7). There were some concerns raised over the loss of additional fishing grounds; however, the footprint required and the additional PSZ have been minimised to reduce impacts.
Other requirements	Physical displacement will be managed in accordance with the applicable legislative requirements.
Monitoring and reporting	Monitoring of potential impacts is undertaken via stakeholder engagement.
Acceptability outcome	**Acceptable**

6.7 Benthic Disturbance

6.7.1 Hazards

Benthic disturbance can occur as a result of activities which interact with the seabed, for example IMR activities such as use and parking of ROV on the seabed, excavation, pipeline repair, replacement of subsea infrastructure and infrastructure, including pipeline, stabilisation. The footprint of all IMR activities will be within the operational area, and where replacement occurs the footprint will not change from the original infrastructure footprint.

Vessel anchoring will not occur during the activity.

6.7.2 Predicted Environmental Impacts

Benthic disturbance can impact on benthic habitats and fauna through smothering and alteration of habitat and localised and temporary increases in suspended sediments near the seabed.

Section 6.6, notes the increased physical presence of the Thylacine infrastructure. The footprint of this infrastructure is estimated to be approximately 6,000 m^2. This footprint includes; flowlines, matresses (for flowline stabilisation) and manifolds that are resting directly on the seafloor. This smothers any benthos that may be present below the infrastructure.

6.7.3 EMBA

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

- Benthic habitats and species assemblages.

6.7.4 Consequence Evaluation

A seabed site assessment was undertaken over the Otway Development gas fields and proposed infrastructure corridors. This included Geographe and Thylacine fields, and the Artisan-1 wellhead location. In relation to benthic habitat within the Artisan, Geographe and Thylacine fields and broader area the following was identified:

- Seabed topography is dominated by exposed rock on the seabed.
- Small patches of very thin transgressive coarse sand are present across the survey area.
- Seabed showed a scattered sessile biota on a sandy seafloor.
- No rocky reefs or outcrops were identified.
- Sandy substrates described for Thylacine and Artisan gas fields are consistent with the reported description for the broader Otway Development area of unconsolidated seabed sediments made up of carbonate sands.
- Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of an unmodified marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m2 on average but could be found in patches of at least 0.4 m2.
- There was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.
- Epibiota on the seabed in the vicinity of the Thylacine and Artisan gas fields is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates. No species or ecological communities listed as threatened under the EPBC Act were observed.

The operational areas overlap the Shelf Rocky Reefs and Hard Substrates KEF. No threatened ecological communities or habitats critical to the survival of the species were identified within the operational areas. The Shelf Rocky Reefs and Hard Substrates KEF is in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break.

The seabed site assessment identified that the substrate was hard substrate within the operational areas but did not identify rocky reefs (Ramboll, 2020. Appendix B). The seafloor supported a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges) which is characteristic of the hard grounds associated with the hard substrates' component of the Shelf Rocky Reefs and Hard Substrates KEF. However, the hard substrate and associated biota characteristic of the hard substrate component of the Shelf Rocky Reefs and Hard Substrates KEF is not unique to the operational areas based on Commonwealth of Australia (2015) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait. This is support by the recent seabed site assessment (Ramboll, 2020. Appendix B), that identified that the epibiota on the seabed in the vicinity of the Thylacine and Artisan gas fields is representative of what is expected at depths around 70-100 m, and also previous surveys within the Otway Basin, as detailed below, that identified hard substrate with similar biota to that in the operational areas.

A comprehensive assessment of the Otway Basin coast to continental shelf margin collecting bathymetric data and video footage for the pipeline right-of-way options was undertaken for the Otway Gas Project EIS (Woodside, 2003) and identified:

- Local topography is predominantly irregular in nature, varying from gently undulating and locally smooth in areas of increased sediment deposition, to areas of outcropping cemented calcrete features that are from smooth to jagged relief. These areas are covered in marine growth. ROV video survey confirmed the presence of a shallow hard underlying substrate at a depth of 50 mm below the sediment in areas of marine growth (JP Kenny, 2012).

- Benthic assemblages (CEE Consultants Pty Ltd, 2003) ranged from very low density sessile; large sponge to diverse, high density sessile: sponge, coral dominated crinoids common and mobile species.

- BBG (2003) found that the substrate in water depths that predominate in the Otway Gas Project operational area (between 82 and 66 m) area was predominantly low profile limestone with an incomplete sand veneer that supported a low to medium density, sponge dominated filter feeding community. Fish and other motile organisms were uncommon.

There is limited information on the recovery of benthic habitats after the removal of equipment. As the affected areas are expected to be like the surrounding seabed it would be expected that following removal of the equipment, sand and other material would begin to fill the area of disturbance and that recolonization would occur. This could take months to a year or more but is unlikely to have lasting effects.

The extent of the area of impact is predicted to be small / within the existing infrastructure footprint for a duration of up to months to years while the disturbed area recolonises. The severity is assessed as Minor (1) based on:

- No threatened ecological communities, critical habitats, sensitive or protected benthic habitat or species, including commercial invertebrate species, have been identified in the area of impact (operational areas).
- Though the operational areas overlap hard substrate similar to that described for the Shelf Rocky Reefs and Hard Substrates KEF this feature, and associated biota are not unique to the operational area based on Commonwealth of Australia (2015) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait, and on surveys within the Otway Basin that identified hard substrate with similar biota to that in the operational areas.
- Due to the small area of disturbance and that the hard substrate habitat and associated biota is not unique to the operational areas the benthic disturbance will not modify, destroy, fragment, isolate or disturb a substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results.
- There is no impediment to the disturbed areas recolonising as the benthic habitat and associated biota is not unique within the operating areas.
- Grout bags and cement from the installation of rock bolts are low toxicity.

6.7.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Benthic disturbance	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from benthic disturbance are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to benthic disturbance. The infrastructure associated with connection of the Thylacine wells has resulted in an increased impact on the environment. This infrastructure has smothered the benthos that was present in the area. The physical footprint of this infrastructure was reduced to an ALARP to ensure safe operations. The seabed and associated benthos in the area is considered to be homogenous (see section 4.3.3) and does not result in the loss of significant habitat. As the impact consequence is rated as Minor (1) applying good industry practice is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#20: IMR Scope of Work	Benthic disturbance is limited to during IMR campaigns. The IMR scope of work will detail activities that may disturb the seabed and how these activities will limit the area of disturbance.
CM#21: Beach OEMS Element 6 Asset Management	The standard defines the minimum requirement for the monitoring and assurance processes that support the ongoing safe and reliable management of an asset throughout its lifecycle. All equipment associated with the Otway Gas Development is inspected, monitored, and maintained in accordance with the CMMS to ensure that it is in good condition and can be safely decommissioned when required.

CM#22: Beach Chemical Management Plan	All chemicals, including grout or cement used for stabilisation methods, will be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Benthic disturbance was assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
External context	There have been no stakeholder objections or claims regarding benthic disturbance.
Other requirements	No other requirements were identified in relation to benthic disturbance.
Monitoring and reporting	Impacts associated with benthic disturbance are over a small area and not predicted to have long term impacts to protected or commercially important receptors. Therefore, the monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.8 Planned Marine Discharges – Vessels

6.8.1 Hazards

Vessels will have planned marine discharges within the operational area such as cooling water, brine, bilge water, deck drainage, putrescible waste, sewage and grey water.

Wastewater and putrescible waste discharges from the Thylacine-A Wellhead Platform are not expected as:

- Wellhead platform is normally unmanned.
- During manned periods, all wastewater and putrescible waste will be contained and transported back to shore.
- Platform is mainly grated to allow rainwater and seawater from the bird deterrent system to easily fall through without resulting in contaminated runoff.
- Liquid collected in the closed drain system is pumped to the production pipeline by the two drain pumps operating in lead/lag mode, before the drain system is vented.
- Chemical storage areas are bunded.

6.8.2 Predicted Environmental Impacts

Planned marine discharges can result in changes in water quality such as increased temperature, salinity, nutrients, chemicals, and hydrocarbons which can lead to toxic effects to marine fauna.

Putrescible waste discharges can result in changes in fauna behaviour if result in fauna habituate to this food source.

6.8.3 EMBA

Predicted impacts from planned marine discharges from vessels will be limited to the operational area. Receptors potentially affected include water quality and marine fauna.

6.8.4 Consequence Evaluation

6.8.4.1 Planned marine discharges

The consequence evaluation considers the potential cumulative impacts from:

- Planned marine discharges of waste waters and putrescible wastes from vessels when undertaking petroleum activities within the operational area.

These discharges will result in:

- Nutrients levels may be intermittently elevated within 500 m of a vessel when sewage, greywater and putrescible waste discharged.
- Water temperature may be elevated within 100 m of the of a vessel from the constant discharge of cooling water.
- Hydrocarbon levels may be intermittently elevated within 100 m of a vessel when bilge waster is discharged.

Cumulative impacts may occur from the vessel discharges if work scopes overlap. This may only occur if re-supply operations at the Thylacine-A Wellhead Platform are undertaken during an IMR campaign. However, vessels undertaking activities under this EP will mostly be moving, increasing the dispersion of wastewater, and reducing the area of potential impacts. The small additional volumes that an additional vessel will discharge and intermittent nature of the discharges, except for cooling water which has a predicted area of impact of 100 m, would be unlikely to significantly increase the impact extent beyond 500 m or the impacts to water quality and marine receptors while concurrent activities are occurring.

For the consequence evaluation, it is assumed that vessels would be operating adjacent to existing infrastructure, therefore all wastewater discharges will dissipate within the operational area (500 m).

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that area ecologically significant.

Fish species, including commercial species maybe present within the operational area. There are no BIAs or protected habitats and commercial fishing for fish species has not been identified within the operational area. No features have been identified where site attached species would be present. As fish species would be transient in the operational area, toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the distribution BIA for white shark by although no critical habitats or behaviours are known to occur. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify vessel discharges or equivalent as a threat. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the operational area though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (CoA, 2017b) though not specifically from vessels and is focus on long term exposure. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the pygmy blue whale high density foraging BIA. The Conservation Management Plan for the Blue Whale (DoE 2015a) does not identify discharges from vessels as a threat to the recovery of these species. It does identify that marine pollution can have a variety of possible consequences for blue whales at an individual and population level, or indirectly through harming their prey or the ecosystem. The conservation plan identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that chemicals associated with a spill is classed as a minor consequence impacts from low toxicity discharges that would rapidly dilute would be expected to be the same or a lower consequence.

The operational area overlaps the southern right whale migration and reproduction BIAs. The Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) do not identify discharges from vessels as a threat to the recovery of these species but does identify chemical pollution in the form of sewage and industrial discharges as a threat more likely in coastal aggregation areas. The conservation plan identifies acute chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that the conservation plan identifies acute chemical discharge as a threat more likely in coastal aggregation areas it would be expected that chemical discharges in an offshore area which would rapidly dilute would be the same or lower consequence.

The South-east Marine Region Profile (CoA 2015) details that the oceanography of the South-east Marine Region contributes to enhanced areas of primary productivity, including:

- Spring and autumn phytoplankton blooms in the Subtropical Convergence Zone (south of Tasmania).
- Primary productivity associated with the Bass Cascade and upwelling of cool nutrient-rich waters along the mainland coast north-east of Bass Strait.
- Localised seasonal upwellings along the Bonney coast.

The closest of these high productivity areas to the Otway Offshore Operations is the Bonney coast upwelling KEF. The Bonney coast upwelling KEF is ~83 km from the operational area. The Bonney coast upwelling KEF is an area of high productivity and aggregations of marine life, of importance as feeding grounds to blue, sei and fin whales and higher predatory species, typically in summer and autumn months. However, based on the large distance between the operational area and the Bonney coast upwelling KEF impacts to water quality and therefore productivity are not predicted.

The extent of impact, including any cumulative impacts, is predicted to be 500 m from a vessel. The severity is assessed as Minor (1) based on:

- Marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- Marine discharges are not predicted to have lasting effects on either the biological or physical environment in the operational area with no specific value when compared with surrounding waters.
- Operational area overlap with the white shark distribution BIA is small; and the Recovery Plan for the White Shark (DSEWPaC, 2013a) does not identify vessel discharges or equivalent as a threat.
- Operational area overlap with the pygmy blue whale foraging BIA is small; and the Conservation Management Plan for the Blue Whale (DoE 2015a) identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- Operational area overlap with the southern right whale reproduction BIA is small; and the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identify acute chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- Marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- Potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- As the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.
- Given the anticipated rapid dilution of low concentration of hydrocarbons and chemicals within the water column, there is no identified potential for decreases in water quality that may impact on marine fauna attracted to regional upwelling events.

6.8.4.2 Putrescible Waste

The operational area where the vessels would discharge putrescible waste overlaps foraging BIAs for several albatross species, common diving-petrel, and short-tailed and wedged-tailed shearwater. No habitat critical to the survival of seabirds occur within the operational area. Marine pollution is

identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a) however, vessel food waste discharge would be sporadic and for a short duration thus would not result in seabirds habituating to this food source. The common diving-petrel (listed as marine) and wedged-tailed shearwater (listed as marine and migratory) do not have a recovery plan or conservation advice.

Fish may also become attracted to the food waste but as for seabirds the sporadic nature of vessel food waste discharge would not lead to fish habituating to this food source.

Periodic discharge of macerated food waste to the marine environment will result in a temporary increase in nutrients in the water column that is expected to be localised to waters surrounding the discharge with no lasting effects to either the biological or physical environment.

The extent of the impact is predicted to be 500 m from the vessel while undertaking activities in the operational area. The severity is assessed as Minor (1) based on:

- Food waste discharges are sporadic and for a short duration thus would not result in fauna habituating to this food source.
- Food waste will rapidly disperse in the marine environment.
- Nutrients within putrescible waste are to be discharged within an area of regionally elevated nutrient levels created by seasonal upwelling events, therefore additional nutrients loading is not likely detrimental to marine fauna.

6.8.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Planned marine discharges – vessels	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims were raised by stakeholders in relation to planned marine discharges. As the impact consequence is rated as Minor (1) applying good industry practice is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#23: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	This Act regulates Australian regulated vessels with respect to ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, putrescible waste, garbage, air pollution etc.
CM#4: Maintenance Management System	Equipment to treat marine discharges such as bilge water, slops from deck drainage, sewage and food waste are operated in accordance with the maintenance management system to ensure efficient operations.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low

Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
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 (CoA, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (CoA, 2020a). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Impact sei or fin whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. The control measures adopted ensure water quality remains within internationally recognised and acceptable parameters therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.9 Planned Marine Discharges – Operations and IMR

6.9.1 Hazards

During operations and IMR activities, planned marine discharges include:

- Hydraulic control fluid discharged during Geographe and Thylacine subsea valve actuation.
- Fugitive discharge of hydraulic fluid through the hydraulic control system.
- Hydraulic control fluid discharge during maintenance and repair of subsea infrastructure (e.g. replacement of hydraulic fluid lead (HFL).
- Dye discharged during IMR activities such as leak testing.

- Chemicals used to remove marine debris.
- MEG discharge during well choke replacement activities.

The Otway Pipeline System is a closed system, with no discharges of MEG or corrosion inhibitor chemicals expected. There are no planned discharges from the Thylacine-A Wellhead Platform, and the closed drain system discharges liquid to the wells with no discharge of treated water. No hydraulic fluid from the Thylacine production wells is released to the marine environment.

Hydraulic fluid is provided to Geographe and Thylacine via the main umbilical from the Thylacine-A Wellhead Platform. It is delivered via the infield umbilical to the Subsea Valve Skid (SVS). Each time the subsea value is actuated a small volume of hydraulic fluid is released. A maximum of 1500 kg per year of hydraulic fluid is released subsea as a result of movements of Geographe and Thylacine tree valves and SVS valves.

During IMR activities, hydraulic control fluid, MEG and other chemicals (such as dye and sulphuric acid) may be used and / or discharged to the marine environment.

All chemicals that will be or have the potential to be discharged to the marine environment that are not included in the Dangerous Goods Manifest Otway will be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application. This assessment will be undertaken using Beach's Hazardous Materials Risk Assessment (CDN/ID 8743319).

6.9.2 Predicted Environmental Impacts

Planned discharges of hydraulic control fluid, MEG and other operational discharges can result in changes in water quality which can lead to toxic effects to marine fauna.

6.9.3 EMBA

Predicted impacts from planned marine discharges from operations and IMR will be limited to the operational area. Receptors potentially affected include water quality and marine fauna.

6.9.4 Consequence Evaluation

Hydraulic control fluids are water-based and readily biodegradable. As open marine waters are typically influenced by regional wind and large-scale current patterns resulting in the rapid mixing of surface and near surface waters any discharges of hydraulic control fluids would disperse rapidly within a small area. The extent within which the hydraulic fluids would disperse is estimated to be with 500 m of the release location. The current hydraulic fluid used offshore Otway is HW443, which has an Offshore Chemical Notification Scheme (OCNS) Group C.

During leak detection, dye is dosed into the system and a visual observation is made (by ROV / diver) to identify if a leak is present. Dyes are typically fluorescent to aid detection, and equipment can be used to detect dye in the water column at very low volumes. As with hydraulic fluid, the open water environment, small volumes and subsea currents means dye is expected to disperse within 500 m from the release location.

Marine debris removal may be aided by the use of chemicals such as Sulfamic Acid (or equivalent such as Citric Acid).

During choke replacement activities a small amount of MEG (up to 75 L) is likely to be release to the marine environment. MEG is a category 'E' OCNS (lowest toxicity rating) chemical with no substitution warning and is readily biodegradable and has a low potential for bioaccumulation.

Within the extent of potential impact, potential receptors to a change in water quality would be plankton, fish, turtles and marine mammals. As the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that area ecologically significant.

Fish species, including commercial species maybe present within the operational areas. There are no BIAs or protected habitats for fish species within the operational area. No features have been identified where site attached species would be present. As fish species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area is within the distribution BIA for white shark, although no critical habitats or behaviours are known to occur. Sharks will be transient through the area thus impacts are not predicted. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify chemical discharges or equivalent as a threat. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the operational area though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (CoA, 2017b) though not specifically from hydraulic control fluid or dye used during leak testing. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

Marine mammals can actively avoid plumes, limiting exposure. The operational area overlaps the pygmy blue whale foraging BIA. The Conservation Management Plan for the Blue Whale (DoE 2015a) does not identify discharges from operations as a threat to the recovery of these species. Though pygmy blue whales could potentially forage within the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the migration and reproduction BIAs for the southern right whale. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify chemical discharges as a threat to the recovery of these species. These species are likely to be transient within the operational area thus toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identifies chronic chemical pollution as a threat with a minor consequence, but no actions are detailed. Chronic toxicity

impacts are not predicted to southern right whales due to the low volume and low toxicity of the marine discharges and rapid dilution.

The extent of the impact is predicted to be 500 m from the discharge point (i.e. within the operational area). The severity is assessed as Minor (1) based on:

- Marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- No sensitive resident receptors or particular values were identified within the area that may be affected when compared with surrounding waters.
- Marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- Potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- Discharges will rapidly disperse in the marine environment.
- Chronic toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

6.9.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Planned marine discharges – operations and IMR	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests, and no significant media interests. No objections or claims where raised by stakeholders in relation to marine discharges of hydraulic control fluids or other operational discharges. As the impact consequence is rated as Minor (1) applying good industry practice is sufficient to manage the impact to ALARP. As the risk is rated as low applying good industry practice is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#22: Hazardous Materials Risk Assessment	All chemicals that could be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
CM#4: Maintenance Management System	Systems that generate or treat planned discharges will be operated in accordance with the computerised maintenance management system (CMMS) to ensure efficient operation
CM#24: Hydraulic Control System	The hydraulic power unit (HPU) on Thylacine-A wellhead platform provides control of Thylacine and Geographe subsea wells. The HPU monitors system pressure and hydraulic fluid inventory and is inspected and maintained in accordance with the CMMS.

Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
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 (CoA, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (CoA, 2020a). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). Impact se or fin whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. The control measures adopted ensure water quality remains within acceptable parameters given the chemicals are assessed to internationally recognised standards, therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.10 Establishment of Invasive Marine Species

6.11 Hazards

The introduction of marine pests could occur during vessel operations as a result of:

- Discharge of ballast water containing foreign species.

- Translocation of species through biofouling of the vessel hull, anchors and/or niches (e.g. sea chests, bilges, and strainers).
- Disposal of contaminated waste and materials.
- Successful IMS invasion requires the following three steps:
- Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
- Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
- Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

6.12 Predicted Environmental Risks

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. However, establishment of introduced marine species is mostly likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

If the risk of establishment of IMS is realised, the following known and potential environmental impacts may occur:

- Change in ecosystem dynamics.
- Changes to the functions, interests or activities of other users.

Change in ecosystem dynamics may include reduction in native marine species diversity and abundance, displacement of native marine species, socio-economic impacts on commercial fisheries, and changes to conservation values of protected area.

6.13 EMBA

Predicted impacts from the risk of establishment of IMS will be limited to the operational area. Receptors potentially affected include marine invertebrates and benthic habitats, and commercial fisheries.

6.14 Consequence Evaluation

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. Establishment of introduced marine species is most likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

In the event of an IMS being introduced to the marine environment, successful colonisation is dependent upon suitable substrate availability. The operational area does not present a location conducive to marine pest survival because it is mostly located in deep waters (offshore infrastructure location in water greater than 70 m (83m – 101m)), however the Otway Pipeline System and HDD entry

point are located in shallower waters (6 m at the HDD entry point; 66 m – 72 m at the Hot Tap Tee locations).

IMS introduced during the activity has the potential to impact ecosystem dynamics. As a result of a change in ecosystem dynamics, further impacts may occur, which include change in the functions, interests, or activities of other users.

Receptors potentially impacted by a change in ecosystem dynamics include:

- Marine invertebrates
- Benthic habitat (soft sediment, macroalgae, soft corals)
- Commercial fisheries.
- Given the distance from planned operations (50 km to closest AMP), no impacts to Australian Marine Parks are predicted.

6.14.1.1 Marine Invertebrates and Benthic Habitats

IMS are likely to have little or no natural competition or predators, thus potentially outcompeting native species for food or space, preying on native species, or changing the nature of the environment. It is estimated that Australia has more than 250 established marine pests, and that approximately one in six introduced marine species becomes a pest (Department of the Environment, 2015). Once established, some pests can be difficult to eradicate (Hewitt et al., 2002) and therefore there is the potential for a long-term or persistent change in habitat structure. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002).

The chances of successful colonisation in the Otway region are considered small given:

- The Fugro seabed survey (2019) identified that the seabed is dominated by exposed rock with very thin transgressive coarse sand and no rocky reefs or outcrops. This type of habitat is not conducive to the establishment of IMS and is outside of coastal waters where the risk of IMS establishment is considered greatest (BRS, 2007).
- The offshore operations are geographically isolated from other subsea or surface infrastructure which might be suitable for colonisation.
- The offshore location of the Thylacine-A wellhead platform and subsea facilities does not present a location conducive to marine pest survival because it is located in deep waters with the operational area in water greater than 70 m (83 m – 101 m).
- Vessel activities at shallower locations (HDD entry point, Hot Tap Tee locations) will be limited to IMR, with no routine activities undertaken in shallower waters.

Areas of higher value or sensitivity are located away from the well sites with Twelve Apostles Marine National Park on the Victorian coast approximately 54 km away from the operational area. While unlikely, if an IMS was introduced, and if it did colonise an area, it is expected that any colony would remain fragmented and isolated, and only within the vicinity of the Thylacine-A Wellhead Platform /

subsea infrastructure (i.e. it would not be able to propagate to nearshore environments, and protected marine areas present in the wider region).

Given the impact of a successful IMS colonisation has the ability to significantly impact local species and thus change local epifauna and infauna populations permanently, the consequences have been evaluated as Serious. However, it is considered such an event is Remote due to the unfavourable conditions within the operational area required for colonisation. As outlined in Section 6.14.2 Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered low.

6.14.1.2Commercial Fisheries

The introduction of IMS has the potential to result in changes to the functions, interest, or activities of other users, including commercial fisheries. Marine pest species can deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific Seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (DSE, 2004). However, areas suitable for commercial scallop fishing are not expected near the well locations; commercially suitable scallop aggregations occur in the waters of eastern Victoria (Koopman et al. 2018).

Whilst it has been assessed that the introduction of an IMS would have a Serious impact on state and Commonwealth fisheries the likelihood has been assessed as Remote. Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered low.

6.14.2 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Establishment of invasive marine pests	
ALARP decision context and justification	ALARP Decision Context: Type B On the basis of the impact assessment completed, Beach considers the control measures described are appropriate to manage the impacts associated with the risk of introduction and establishment of IMS. The Victorian DJPR (now DEECA) have expressed interest in the management of IMS in Victorian State waters.
Adopted Control Measures	**Source of good practice control measures**
CM#25: Beach Domestic IMS Biofouling Risk Assessment Process	All vessels mobilised from domestic waters to undertake offshore petroleum activities within the operational area must complete the Beach Domestic IMS Biofouling Risk Assessment Process as detailed in the Beach Introduced Marine Species Management Plan (S400AH719916) prior to the initial mobilisation into the operational area. The Beach Domestic IMS Biofouling Risk Assessment Process: • Validates compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational area. • Identifies the potential IMS risk profile of vessels and submersible equipment prior to deployment within the operational area. • Identifies potentially deficiency of IMS controls prior to entering the operational area. • Identifies additional controls to manage IMS risk.

	• Prevents the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).

Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Only use vessels that are based in Victoria to reduce the potential for introducing IMS.	Equipment	Specialised IMR vessels are likely required to undertake IMR activities. Using vessels that are based in Victoria (if available) may reduce the likelihood of introducing an IMS, but this would depend on the IMS risk level of the port where the vessel is based. The control measures that are to be implemented are required to be undertaken for vessels from any port in Victoria or Australia. Thus, there is limited environmental benefit associated with implementing this response.	Not selected

Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of the establishment of IMS was assessed as low and the consequence was assessed as serious which has the potential to result in serious or irreversible environmental damage. However, this is assessed as acceptable based on: • There is little uncertainty associated with this aspect as the activities are well known, the cause pathways are well known, and activities are well regulated and managed. • No impacts to MNES are predicted. • The implementation of controls make it a remote likelihood that IMS will be introduced from the activity resulting in a low residual risk. • It is not considered that there is significant scientific uncertainty associated with this aspect. Therefore, the precautionary principle has not been applied.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
External context	There have been no stakeholder objections or claims regarding the introduction or establishment of invasive marine pests in relation to the activity.
Other requirements	The impact will be managed in accordance with legislation requirements and guidance, including: • Offshore Installations Biosecurity Guide (DAWE 2020) • National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (MPSC 2018)

	• Australian Ballast Water Management Requirements (CoA, 2020) and Australia Biofouling Management Requirements (DAWE 2022) gives effect to the Biosecurity Act 2015 and associated regulations; International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) and relevant guidelines or procedures adopted by the Marine Environment Protection Committee of the International Maritime Organization (IMO) • IMO Biofouling Guidelines There are no EPBC management plans (management plans, recovery plans or conservation advice) which relate specifically to IMS introduction and establishment as a threat. The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies IMS, and diseases translocated by shipping, fishing vessels and other vessels as a threat to the AMP network. The implementation of the controls make it unlikely that IMS will be introduced from the activity and spread to nearby AMPs.
Monitoring and reporting	Impacts as a result of the introduction of marine invasive species will be monitored and reported.
Acceptability outcome	**Acceptable**

6.15 Disturbance to Marine Fauna

6.15.1 Hazards

Disturbance to marine fauna could occur as a result of activities within the operational area, through:

- Vessel operations resulting in collision with marine fauna.
- Bird deterrent system on the Thylacine-A Wellhead Platform disturbing birds.

6.15.2 Potential Environmental Impacts

Disturbance to marine fauna can result in injury or death.

Disturbance to fauna from underwater noise emissions is addressed in Section 6.4 and 6.5.

6.15.3 EMBA

Predicted impacts resulting from the risk of disturbance to marine fauna will be limited to the operational area. Receptors include marine fauna, specifically slow moving marine fauna and seabirds.

6.15.4 Consequence Evaluation

Marine fauna species most susceptible to vessel strike are typically characterised by one or more of the following characteristics:

- Commonly dwells at or near surface waters.
- Often slow moving or large in size.
- Frequents areas with a high levels of vessel traffic.
- Fauna population is small, threatened, or geographically concentrated in areas that also correspond with high levels of vessel traffic.

The National Strategy for Mitigating Vessel Strike of Marine Mega-fauna (CoA, 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 (CoA, 2017b) identified vessel strike as a threat.

Two species of pinniped may occur within the operational area: the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Twenty two whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); no other important behaviours were identified. The operational area intersects the migration and reproduction BIAs for the southern right whale and a foraging BIA for the pygmy blue whale. The Conservation Management Plan for the blue whale and the southern right whale, Conservation Advice for the sei whale and fin whale and Conservation Listing for the humpback whale identify vessel strike as a threat.

Protected species vulnerable to vessel strikes are identified as being transient in the area except for pygmy blue whales within the foraging BIA and southern right whales in the migration and reproduction BIAs.

Pygmy blue whales are likely to be foraging within the BIA (November to June) which overlaps the period of the activity. The Conservation Management Plan for the Blue Whale (DoE 2015a) detail that collisions will impede the recovery of blue whale populations if a sufficient number of individuals in the population lose reproductive fitness or are killed.

Southern right whales are likely to be present in the migration BIA during April to end of October and reproduction BIA May to September, however, as per CM#13b no IMR activities will be planned within 3 km of the southern right whale reproduction BIA during May to end of September when southern right whales are potentially present.

The occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.

Birds are often on offshore platforms as they provide a safe and relatively undisturbed site for birds to roost. This is particularly the case for unmanned platforms, where human presence is limited to infrequent visits. Quadrant Energy (2017) noted that bird management was required for their unmanned offshore platforms to "*reduce the risk to helicopters of bird strike (which was identified as a major accident event (MAE)…); and to reduce guano loading which obscures critical helipad markings, reduces friction on the helipad and causes equipment downtime*."

On the Thylacine platform crested terns and gannets roost on the helideck, support structures, and crane boom (Avisure 2016). The birds found on the helideck pose a hazard to safe helicopter operations by increasing the risk of bird collision and potential harm to both marine fauna and human life (there have been multiple incidents recorded when helicopters were unable to safely land and have had to return to the heliport).

As noted above guano, can cover important safety marking on the helideck as well as being a slip hazard as can be seen in Figure 15.

Figure 15: Birds on the Thylacine Platform Helideck

Crested terns (*Thalasseus bergii*) and the Australasian gannet (*Morus serrator*) have been confirmed as the species that are predominantly on the platform. These are listed species but not threatened species and are not covered by a species specific management plans.

The Crested tern and Australasian gannet are included in the species profile section of the Wildlife Conservation Plan for Seabirds (WCPS) (CoA 2020a). The WCPS notes that there are up to 1 million Crested terns and they are vulnerable to human disturbance on their onshore breeding grounds. The numbers of Australasian gannets were not known; however, they were described as increasing in number.

The WCPS identifies resource extraction as a threat to seabirds; however, it should be noted that this predominantly covers onshore extraction from mining, which has severe negative impacts on breeding success. In relation to offshore oil and gas platforms the WCPS states that "*seabirds are known to aggregate around oil and gas platforms in above average numbers due to night lighting, flaring, food concentrations and other visual cues*" (Wiese et al. 2001).

The WCPS states that "*implementing a comprehensive monitoring program of impacts of these offshore platforms should include nature, timing and extent of bird mortality caused by these structures. This information can then be used to better inform regulators responsible for exploration and extraction proposals. Proposals for oil and mineral exploration should be adequately assessed and, as appropriate, conditions imposed to ensure that there are no adverse effects on seabirds or their habitats*". The Thylacine platform is a considerable distance from shore so it is considered that the platform will not have any adverse impacts on seabird habitat.

As noted above birds roosting on the platform helideck creates significant safety issues. The Civil Aviation Safety Authority (CASA) Advisory Circular AC 139-26(0) – Wildlife Hazard Management at Aerodromes (the Circular) states the following:

"6.1 Aviation safety statistics have demonstrated that wildlife can pose a significant hazard to the safe conduct of aircraft operations. According to recent worldwide data, the vast majority of wildlife strikes occur either on or within the immediate vicinity of an aerodrome.

"6.2 In many wildlife strike events, damage is sustained to the aircraft involved and/or the aircraft is delayed to allow for an inspection of possible damage. In more serious cases, the damage from a strike could result in the aircraft being unable to maintain safe operations."

Beach has, therefore, developed an Adaptive Bird Management plan to reduce the risk of bird strikes. This Adaptive Bird Management Plan was developed by bird management specialist (Avisure 2016 & 2017) to ensure that appropriate management actions are implemented to deter birds from the platform. This Adaptive Management Plan was based on the fifteen recommendations for deterring birds from the helideck. The recommendations were based on four key areas; minimise the bird attraction to the helideck, reducing perching opportunities, monitoring bird activities, and optimise flight operations to reduce birdstrike risk.

This minimisation of bird attraction to the helideck and reducing perching opportunities were implemented by:

1. Installation of spikes, bird wires and anti-perch wire wherever practicable to reduce perching and roosting opportunities. These were affixed to upper surfaces of known bird perching areas in 2016 and were considered to be effective where they were installed (Avisure 2017).

2. The use of water sprays. These sprays are installed around the helideck (where wires and spikes are impractical). The sprays use sea water as a deterrent to the seabirds. The spray is at a low-pressure rate and does not harm the birds and encourages them to leave the helideck.

3. The use of marine horns. If the use of water sprays is not an effective deterrent, then the marine horns are sounded. The horn used is Kahlenberg KB-20 marine horn. This is a standard marine horn fitted on vessels up to 75 m in length and emits a signal of over 130 dB.

The Avisure Report (2017) noted that "despite all efforts to eliminate birds from using the platform, it is likely that some will occasionally be present" and during their inspection in 2017 "around 20 birds were present on the vent prior to take-off" with the pilot have to "expeditiously climbed and headed in a direction away from the birds". There have been numerous instances where landings have had to be aborted due to birds still being present on the helideck.

To address this issue Avisure recommended that a bird laser be installed on the helideck.

The laser is a design used to deter birds in agricultural areas and at onshore airfields. The design is similar to the one approved for use on Santo's Reindeer and John Brookes platforms offshore Western Australia (E2020/0173).

An AVIX Autonomic Mark II laser has been installed on the Platform; however, it has not been operational since the installation. This is a Class 3B laser with a maximum output of <500 mW with a wavelength of 532 nm (AVIX Autonomic Mark II User Manual – Version 1.0). The Nominal Ocular Hazard Distance (NOHD) is quoted as being approximately 320 m (lasersafetyfacts.com). The laser was installed by a specialist bird control company (Bird Control Group) to ensure that the laser was correctly focused on to the helideck. This avoids the laser being directed into the eyes of any birds or

individuals on the helideck (please see Figure 16, which provides an example of this type of laser in operation).

Figure 16: Bird laser deterrent in operation

Table 14 details the shorebirds and seabirds that may be foraging, breeding, roosting, or migrating within the light EMBA and may be attracted to the platform. These were identified from the light EMBA PMST Report (Appendix A.3) and BIAs from the National Conservation Values Atlas.

In addition to this, Pendoley Environment Limited (Pendoley), produced a report for Beach in 2021 that identified species that could in the Otway area. This used the PMST Report plus the additional reports on birdlife in south-east Australia, including:

- Approved Conservation Advice for the *Halobaena caserulea* (blue petrel);
- Approved Conservation Advice for *Pterodroma mollis* (soft-plumaged petrel);
- Approved Conservation Advice for *Stenula nereis nereis* (Australian fairy tern);
- Approved Conservation Advice for *Pachyptila subantarctica* (fairy prion (southern));
- Approved Conservation Advice for *Calidris canutus* (red knot);
- Conservation Advice *Calidris ferruginea* (curlew sandpiper);
- Draft National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*);
- Conservation Advice for *Numenius madagascariensis* (eastern curlew);
- South-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region;
- National recovery plan for threatened albatrosses and giant petrels 2011 – 2016;

- National Recovery Plan for the *Neophema chrysogaster* (orange-bellied parrot);
- National Recovery Plan for *Pterodroma leucoptera leucoptera* (Gould's petrel); and
- Wildlife Conservation Plan for Migratory Shorebirds (2015).

Bird species identified using the above were categorised on the expected presence in the Thylacine area into; known to occur, likely to occur and potential to occur.

This categorisation identified eleven (11) species that were known to occur, with a further twenty (20) likely to occur, and sixteen (16) potential to occur within 20 km of the Platform. This is a total of 47 species.

This report (Pendoley 2021), provides a detail assessment of the impact of light on seabirds, which is summarised in Table 9 of the report and repeated below.

Table 27: Summary of highest vulnerability ranking for bird groups

Species group	Species subgroup	Highest vulnerability score	EPBC Act Listing	Wavelength sensitivity
Seabirds	Procellariforms	Highest	Endangered	Ultraviolet – blue – green
	Charadriformes	Lowest	Listed/Endangered	Ultraviolet – blue - green
	Spheniscisformes	Lowest	Listed	Ultraviolet – blue - green
Shorebirds	Sku/terns	Lowest	Vulnerable	Foraging: Ultraviolet – blue
	Waders	Moderate	Critically endangered	Migrating: Red
Terrestrial birds	Psittaciformes	Moderate	Critically endangered	Migrating: Red
	Apodiformes	High	Listed	Migrating: Red
	Accipitriformes	Lowest	Listed	Migrating: Red

As noted above, the light from the laser is green and, therefore, the subspecies group Procellariforms, Charadriformes and Spheniscisformes are the most sensitive to this wavelength and would be considered to be species of concern.

Of these subspecies, Procellariforms are identified as having the highest vulnerability. This group consists of albatrosses, shearwaters, petrels and prions. None of these species have ever been recorded on the helideck of the Thylacine platform.

Although the bird deterrent system has been designed to avoid injury to birds, it is possible that operation of the bird deterrent system may injure or kill birds either through entangled in netting below the helideck. The bird deterrents (primary and secondary methods) are designed to scare birds, rather than injure them to ensure safety risks associated with helicopter operations are adequately managed. The water sprinkler is used daily (when birds are present), even when helicopter flights are

not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers, and hence lowering the risk of being harmed.

The laser is proposed to be used during the days prior to helicopter operations to the platform to deter birds from roosting on the platform prior to the arrival of the helicopter. This would reduce the potential for bird fatality due to impact with the helicopter and potentially fatal consequences for the helicopter crew. It is initially proposed that the laser is used at dusk and dawn to provide birds the time to find alternative roosts in the area, as recommended by the vendor. The laser will also be trialled at night to determine whether there is any additional effectiveness in preventing birds from roosting.

In addition, prior to the use of the laser the PIC (or delegate) will monitor the video feed from the platform to determine the species of bird present on the platform to ensure there are no species of concern. Where the PIC (or delegate) is uncertain of the species they will contact the Senior Environmental Advisor for assistance. Where species of concern identified the laser would not be activated unless there was a significant safety requirement to do so.

The extent of the area where disturbance to marine fauna may occur is within the operational area and the risk could occur while the activity is undertaken. The severity is assessed as moderate and likelihood as highly unlikely based on:

- Within the operational area vessels will be slow moving to stationary.
- The occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.
- The bird deterrent system is designed to scare birds, rather than injury them.
- If an incident occurred, it would be restricted to individual fauna.

6.15.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Disturbance to marine fauna	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of disturbance to marine fauna is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the risk is rated as low applying good industry practice is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels.
CM#26: Bird Deterrent system	Operators of the bird deterrent systems are trained and follow standard operating systems.

	The water sprinkler is used daily (when birds are present), even when helicopter flights are not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers and hence lowering the risk of being harmed. Bird laser would initially be used for a limited time at dusk and dawn prior to scheduled helicopter operations. Further trials will be undertaken to determine whether nighttime operations would be effective. Monitoring of the platform cameras will be used to determine that there are no species of concern on the helideck prior to operation of the laser.
CM#13b SRW Exclusion Zone	No IMR activities will be planned within 3 km of the southern right whale reproduction BIA during April to end of September when SRW are potentially present in the BIA. As this BIA is where southern right whales are resting or calving, they are more at risk from a vessel collision. The Conservation Management Plan for the Southern Right Whale details that reducing ship strike mortality can be most easily done either by reducing vessel speed or by separating vessels and whales. This also aligns with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). The implementation of an exclusion zone for this area, in addition to the slow vessel speeds that survey vessels will be operating at within the migration BIA, will ensure that the activity is not inconsistent with the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a).
Consequence rating	Moderate (2)
Likelihood of occurrence	Highly Unlikely (2)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of disturbance to marine fauna was assessed as low and the consequence was assessed as moderate which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
External context	There have been no stakeholder objections or claims regarding disturbance to marine fauna.
Other requirements	Disturbance to marine fauna will be managed in accordance with legislative requirements. Disturbance to marine fauna if it occurred will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (CoA 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022).

	• Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). 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) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Impact the recovery of sei or fin whales, covered by conservation advice. The activity is not inconsistent with the Wildlife Conservation Plan for Seabirds (CoA 2020a) as the bird deterrent system is designed to scare birds, rather than injury them. Applicable actions associated with the plan have been addressed as per: • Implementing a comprehensive monitoring program of impacts of these offshore platforms should include nature, timing and extent of bird mortality caused by these structures. Beach records any injury/deaths of bird species associated with the platform, and these are reported to NOPSEMA as recordable incidents. Actions from the Conservation Management Plan for the Blue Whale (DoE 2015a) 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. • Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented. Section 6.15 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity to minimise vessel collisions have been addressed as per: • Assess risk of vessel strike to Southern Right Whales in BIAs to ensure impacts are of an acceptable level and ALARP. • Ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs. • Ensure all vessel strike incidents are reported in the National Ship Strike Database managed through the Australian Marine Mammal Centre, Australian Antarctic Division.
Monitoring and reporting	Vessel strikes to protected marine fauna area required to be.
Acceptability outcome	**Acceptable**

6.16 Unplanned Marine Discharges - Solids

6.16.1 Hazards

Solids which may be accidentally discharged include:

- Waste maybe accidently blown overboard off the vessels or Thylacine-A Wellhead Platform.

- Grit may be used to remove paint or debris from the platform topside during maintenance. Containment will be used to recover grit and debris; however unplanned discharges may occur.

6.16.2 Predicated Environmental Impacts

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

6.16.3 EMBA

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

6.16.4 Consequence Evaluation

The Threat Abatement Plan for the impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (CoA, 2018) details harmful marine debris impacts on a range of marine life, including protected species of birds, sharks, turtles and marine mammals. Harmful marine debris refers to all plastics and other types of debris from domestic or international sources that may cause harm to vertebrate marine wildlife. This includes land sourced plastic garbage (e.g. bags, bottles, ropes, fibreglass, piping, insulation, paints and adhesives), derelict fishing gear from recreational and commercial fishing activities and ship-sourced, solid non-biodegradable floating materials lost or disposed of at sea.

Solids accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement. Impacts will be restricted in exposure and quantity and will be limited to individual fauna.

The operational area overlaps foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. No habitat critical to the survival of birds occur within the operational area. Marine debris is identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022).

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 (CoA, 2017b) identified marine debris as a threat.

Two species of pinniped (or species habitat) may occur within the operational area; the New Zealand fur-seal and the Australian fur-seal. The operational area does not overlap any BIAs for pinnipeds.

Twenty two whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects a foraging BIA for the pygmy blue whale and the migration and reproduction BIAs for the southern right whale.

The Conservation Management Plan for the blue whale and for the southern right whale and Conservation Advice for the sei whale and fin whale do not identify marine debris as threat. The Conservation Listing for humpback whales identifies marine debris as threat.

The draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identifies marine debris as a threat, specifically vessel-sourced, solid, non-biodegradable floating materials disposed of

or lost at sea. It details that ingestion of marine debris, however, is thought to be unlikely for southern right whales in Australian coastal waters given whales are less likely to be feeding. No actions from the recovery plan were identified specific to vessel debris.

The extent of the area of where the risk of unplanned waste being discharged to the marine environment is within the operational area and the risk could occur at any time. The severity is assessed as Minor (1) and remote as unplanned release of waste is uncommon; if waste was lost overboard impacts would be restricted in exposure and quantity and would be limited to individual fauna.

6.16.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Unplanned marine discharges - Solids	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of an unplanned marine discharge of solids impacts to marine fauna is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation unplanned marine discharge of solids. As the risk is rated as low applying good industry practice is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#27: MO 95: Marine Pollution Prevention – Garbage	Marine Order Part 95 (Marine pollution prevention — garbage gives effect to MARPOL Annex V. MARPOL is the International Convention for the Prevention of Pollution from Ships and is aimed at preventing both accidental pollution, and pollution from routine operations. Specifically, MARPOL Annex V requires that a garbage / waste management plan and garbage record book is in place and implemented.
CM#28: Fabric Maintenance	Grit blasting on the platform jacket and topsides uses containment and recovery to minimise losses to the ocean. Grit blasting material will meet the requirements of the Chemical Management Plan.
Consequence rating	Minor (1)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a marine fauna injury or death from unplanned discharge of solids was assessed as low and the consequence was assessed as minor which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.

External context	There have been no stakeholder objections or claims regarding marine fauna injury or death from unplanned discharge of solids
Other requirements	Waste on board the vessels and Thylacine-A Wellhead Platform will be managed in accordance with legislative requirements. Marine fauna injury or death from unplanned discharge of solids if occurred will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (CoA 2017b). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA 2022). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) and draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (CoA 2020a). • Impact the recovery of sei or fin whales, covered by conservation advice.
Monitoring and reporting	Unplanned discharge of solids is required to be reported
Acceptability outcome	**Acceptable**

6.17 Loss of Containment – Hazardous Substances

6.17.1 Hazards

Several loss of containment scenarios of hazardous substances have been identified as credible during Otway Offshore Operations. These are described in Table 28.

Table 28 Credible Loss of Containment (hazardous substances) scenarios

Scenario	Description
Loss of Containment – hazardous substances stored on Thylacine-A Wellhead Platform and vessels	Routine operation of the Thylacine-A Wellhead Platform and vessels includes handling, use and transfer of hydrocarbons and chemicals with the following were identified as potentially leading to a loss of containment event: • use, handling and transfer of hydrocarbons and chemicals on board • hydraulic line failure from equipment
Loss of Containment – hose failure	Hose failure during transfer of hazardous substances could occur as a result of equipment damage, resulting in a loss of containment of the hose volume.
Loss of containment – MEG pipeline	The MEG pipeline is a closed system; however, loss of containment could occur as a result of: • equipment damage • loss of pipeline integrity • dropped objects

6.17.2 Predicted Environmental Impacts

The predicted environmental impacts of a loss of containment (hazardous substances) are:

- Change in water quality.
- As a result of a change in water quality, further impacts may occur, which include:
- Injury / mortality to fauna.
- Change in fauna behaviour.
- Change in ecosystem dynamics.
- Changes to the functions, interests or activities of other users.

6.17.3 EMBA

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

6.17.4 Consequence Evaluation

An evaluation of the types of minor spill events was completed to determined indicative volumes associated with each type of event. Both hydraulic line failure and use of hazardous materials onboard were associated with small volume spill events – with the maximum volume based upon the loss of an intermediate bulk container ~1 m^3.

The estimated fluid inventory of the MEG pipeline is approximately 550 m^3, based on 82 km of DN 100 pipe. Typically, the MEG pipeline is 80-90 wt% MEG: 10-20 wt% water mixture plus a corrosion inhibitor and alkyl hydroxide.

MEG is a category 'E' OCNS chemical with no substitution warning and is readily biodegradable and has a low potential for bioaccumulation.

The potential consequence of a loss of containment of hazardous substances within the operational area would be limited to a localised and temporary change in water quality in the vicinity of the release, and the potential change to fauna behaviour within surface waters affected by the spill, such as avoidance. As such, the consequence of this scenario has been evaluated as Minor (1) given there is unlikely to be a lasting effect to biological and physical environment in an area that is not formally managed.

6.17.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Loss of Containment – hazardous substances	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of a minor spill is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to minor spills during the activity.

	As the risk is rated as low applying good industry is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#29: Spill containment	Vessel management system includes provision to maintain spill containment aboard the vessel and clean spills aboard the vessel to prevent release to the marine environment. Computerised Maintenance Management Plan (CMMS) on the platform requires that bunded areas are maintained to prevent unplanned spills of chemicals to the marine environment. Spill kits are present on the Thylacine-A Wellhead Platform.
CM#30: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a Shipboard Marine Pollution Emergency Plan (SMPEP) or SOPEP (according to class) is required. These will follow the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
CM#31 NOPSEMA accepted Safety Case	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 set out the requirements for safety cases. The Thylacine-A Wellhead Platform and Otway Pipeline System Safety Cases demonstrate how the risks to the integrity of the MEG system will be reduced to as low as reasonably practicable (ALARP). The safety cases: • identify the hazards and risks. • describe how the hazards and risks are controlled. • describe the management system in place to ensure the controls are effectively and consistently applied. • describe the operation, monitoring, inspection and maintenance of the MEG system. • describe the leak detection, and emergency shutdown and isolations systems to reduce the extent of loss of containment of MEG.
CM#32: Thylacine-A Wellhead Platform Hose Integrity Management Plan	Hoses are managed and maintained as per Thylacine-A Wellhead Platform Hose Integrity Management Plan
Consequence rating	Minor (1)
Likelihood of occurrence	Unlikely (3)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a loss of containment (hazardous substances) was assessed as low and the consequence was assessed as minor which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.
External context	There have been no stakeholder objections or claims regarding loss of containment (hazardous substances).

Other requirements	Loss of containment (hazardous substances) will be managed in accordance with legislative requirements. Loss of containment (hazardous substances) will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (CoA, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (CoA, 2020a). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (DoE 2015a). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact the recovery of sei or fin whale, covered by conservation advice.
Monitoring and reporting	Loss of containment (hazardous substances) are required to be reported.
Acceptability outcome	**Acceptable**

6.18 Loss of Containment - Hydrocarbons

6.18.1 Hazards

Activities associated with the Otway Offshore Operations have the potential to result in an accidental release of hydrocarbons to the marine environment.

Guidance on the identification of worst-case credible spill scenarios is given in AMSA's Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities (AMSA 2015) and Technical Report on Calculation of Worst-Case Discharge (SPE 2016). These documents were used to identify potential hydrocarbon spill scenarios for the Otway Offshore Operations as detailed in Table 29.

There is no refuelling of vessels within the operational area.

Table 29 Loss of Containment Resulting in a Hydrocarbon Spill Scenarios

Scenario	Description	Worst-case release volume and rate
Vessel Collision - Marine Diesel Oil (MDO) spill	Collision between a resupply or IMR vessel and third-party vessel.	Based on the types of vessel used for IMR and resupply activities a largest tank volume of 300 m^3 is considered appropriate.

Scenario	Description	Worst-case release volume and rate
Pipeline loss of containment – gas and condensate	Loss of containment from the Otway Gas Pipeline or flexible flowline from the Geographe or Thylacine subsea facilities as a result of erosion, corrosion, or external forces (e.g. dropped object; fishing vessel interactions). A release could occur anywhere along the flowline or pipeline.	A Flow Assurance assessment calculated that the maximum credible spill volume from a pipeline loss of containment is between 320 to 560 m^3, depending on production rates and the production wells online.
Loss of well containment – gas and condensate	Loss of containment as a result of well integrity failure.	The highest maximum production rates for each producing field are: • Geographe subsea wells: 40 MMscf/day with an associated condensate rate of 640 bbls/day (101.7 m^3/day). • Thylacine-A Wellhead Platform wells - 28 MMscf/day with an associated condensate rate of 280 bbls/day (44.5 m^3/day). • Thylacine wells - 139 MMscf/day with an associated condensate rate of 1,337 bbls/day (212.6 m^3/day). It is likely that these rates would decline by 2-3% per month of flowing time.

6.18.2 Quantitative Hydrocarbon Spill Modelling

Beach commissioned RPS Group (RPS) to conduct quantitative spill modelling for a MDO and a condensate spill scenario.

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

For details of the spill modelling see the RPS Reports in Appendix E.

Scenario 1: a 212.6 m^3 subsea release of condensate over 86 days (RPS 2023) (Appendix E.1).

The modelled scenario was based on a loss of control of a subsea well at the Thylacine West-1 well location using the condensate composition of the Thylacine field.

The Thylacine West-1 well was selected as this has the highest flow rate for the Thylacine and Geographe production wells as detailed in Table 29.

Beach has a high degree of confidence in the estimated release rates as they are based on known reservoir properties and flow rates. Release rates and volumes are based on a total LOC which assumes the failure of multiple control systems.

The modelled duration of 86 days represents the time determined to implement a full dynamic well kill via the drilling of a relief well at any of the well locations.

The loss of containment from the Thylacine West -1 well represents the greatest potential extent of hydrocarbon exposure and is therefore used to evaluate the potential consequences of a loss of containment of condensate. To develop the condensate planning area the low threshold area of exposure from the modelling was used.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2023, Appendix E.1) are detailed in Table 31 and assessed in Table 32 (surface),

Table 33 (shoreline) and Table 34 (in-water)

Scenario 2: a 300 m^3 surface release of marine diesel oil (MDO) over 6 hours (RPS 2022) (Appendix E.2).

This scenario represents a loss of inventory from the largest fuel tank on a supply or IMR vessel due to a hypothetical vessel collision incident. The calculation of discharge volume and timing aligns with the methodology recommended in the AMSA Technical guidelines for preparing contingency plans for marine and coastal facilities (CoA, January 2015).

The most feasible vessel collision scenario is at the Thylacine platform and represents the greatest potential extent of hydrocarbon exposure and is therefore used to evaluate the potential consequences of a loss of containment of diesel. To develop the diesel planning area the low threshold area of exposure from the modelling was used.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2022, Appendix E.2) are detailed in Table 31 and assessed in Table 32 (surface),

Table 33 (shoreline) and Table 34 (in-water).

6.18.3 Hydrocarbon Exposure Thresholds

In the event of an oil spill incident, the environment may be affected in several ways, depending on the concentration and duration of exposure of the environment to hydrocarbons. The hydrocarbon exposure thresholds used for the spill modelling are based on the NOPSEMA Bulletin: Oil Spill Modelling (NOPSEMA 2019) and are detailed in Table 30.

These thresholds have been used to:

- Predict potential hydrocarbon exposure at conservative (low exposure) concentrations to inform the description of the environment.
- Inform the oil spill impact and risk evaluation (diesel and condensate).
- Inform oil spill response planning based on the actionable thresholds of:
    - Surface moderate exposure (10 g/m^2). As detailed in the OPEP Beach use the more conservative moderate exposure for oil response planning.
    - Shoreline moderate exposure (100 g/m^2).

- Inform oil spill monitoring planning (Section 8.1.3 and OSMP) based on the low exposure thresholds.

Table 30: Hydrocarbon Exposure Thresholds

	Threshold	Description
Surface		
Low exposure	1 g/m^2	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring.
Moderate exposure	10 g/m^2	Approximates lower limit for harmful exposures to birds and marine mammals.
High exposure	50 g/m^2	Approximates surface oil slick and informs response plan.
Shoreline		
Low exposure	10 g/m^2	Predicts potential for some socio-economic impact.
Moderate exposure	100 g/m^2	Loading predicts area likely to require clean-up effort.
High exposure	1000 g/m^2	Loading predicts area likely to require intensive clean-up effort.
Dissolved*		
Low exposure	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
Moderate exposure	50 ppb	Approximates potential toxic effects, particularly sublethal effects to sensitive species.
High exposure	400 ppb	Approximates toxic effects including lethal effects to sensitive species
Entrained*		
Low exposure	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
High	100 ppb	As appropriate given oil characteristics for informing risk evaluation.

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

Table 31: Identification of Receptors Predicted to be Exposed to Oil from the Oil Spill Modelling

* Identified in the PMST Report for the planning area but either not on the coastal area or not identified in the spill modelling reported as being exposed to oil.

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
State Waters	Victorian	✓	×	×	✓	✓	×	✓	✓
	Tasmanian	✓	×	×	✓	✓	×	✓	✓
World Heritage Properties	None present	–	–	–	–	–	–	–	–
Australian Marine Parks	Apollo Marine Park	×	×	✓	✓	×	×	✓	✓
	Beagle Marine Park	×	×	×	×	×	×	✓	×
	Franklin Marine Park	×	×	×	×	×	×	✓	✓
	Zeehan Marine Park	×	×	×	✓	×	×	✓	✓
National Heritage Places	Great Ocean Road and Scenic Environs (historic)	✓	×	×	×	✓	×	×	×
	Western Tasmania Aboriginal Cultural Landscape	×	×	×	×	✓	×	×	×
Commonwealth Heritage Places	Cape Wickham Lighthouse*	×	×	×	×	×	×	×	×
	Wilsons Promontory Lighthouse*	×	×	×	×	×	×	×	×
Protected Underwater Cultural Heritage	None present	–	–	–	–	–	–	–	–
Wetlands of International Importance	Lavinia*	×	×	×	×	×	×	×	×
Nationally Important Wetlands	Aire River/Lower Aire River Wetlands	✓	×	×	×	✓	×	×	×
	Lavinia*	×	×	×	×	×	×	×	×
	Princetown	×	×	×	×	✓	×	×	×
	Shallow Inlet Marine and Coastal Park*	×	×	×	×	×	×	×	×
	Western Port	×	×	×	×	✓	×	×	×
	Bunurong Marine National Park*	×	×	×	×	×	×	×	×

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
Victoria Marine Protected Areas	Marengo Reefs Marine Sanctuary*	×	×	×	×	×	×	×	×
	Point Addis Marine National Park*	×	×	×	×	×	×	×	×
	Shallow Inlet Marine and Coastal Park	×	×	×	×	×	×	✓	×
	The Arches Marine Sanctuary*	×	×	×	×	×	×	×	×
	Twelve Apostles Marine National Park	×	×	×	✓	×	×	✓	✓
	Wilsons Promontory National Park	×	×	×	×	×	×	✓	✓
Victorian Terrestrial Protected Areas	Aire River Heritage River*	×	×	×	×	×	×	×	×
	Bay of Islands Coastal Park*	×	×	×	×	×	×	×	×
	Cape Liptrap Coastal Park*	×	×	×	×	×	×	×	×
	Great Otway National Park	✓	×	×	×	✓	×	×	×
	Phillip Island Nature Park	×	×	×	×	✓	×	×	×
	Port Campbell National Park	×	×	×	×	✓	×	×	×
	Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks	×	×	×	×	✓	×	×	×
Tasmanian Marine Protected Areas	Kent Group National Park*	×	×	×	×	×	×	×	×
Tasmanian Terrestrial Protected Areas	Cape Wickham Conservation Area	✓	×	×	×	✓	×	×	×
	Cataraqui Point Conservation Area	✓	×	×	×	✓	×	×	×
	Porky Beach Conservation Area	×	×	×	×	✓	×	×	×
	Seal Rocks State Reserve	✓	×	×	×	✓	×	×	×
	Stokes Point Conservation Area	✓	×	×	×	✓	×	×	×
	West Point State Reserve	×	×	×	×	✓	×	×	×
Key Ecological Features	Bonney Coast Upwelling*	×	×	×	×	×	×	×	×
	West Tasmanian Marine Canyons	×	×	✓	✓	×	×	✓	✓
	Shelf Rocky Reefs and Hard Substrates*	×	×	×	×	×	×	×	×
	Bass Cascade*	×	×	×	×	×	×	×	×

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
Threatened Ecological Communities	Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	✓	×	×	×	✓	×	✓	✓
	Giant Kelp Marine Forests of South East Australia	×	×	×	✓	×	×	✓	✓
	Subtropical and Temperate Coastal Saltmarsh	✓	×	×	✓	✓	×	✓	✓
Benthic Habitats and Species Assemblages	Seagrass Algae Coral	×	×	×	✓	×	×	✓	✓
Mangroves	None present	–	–	–	–	–	–	–	–
Saltmarsh	Saltmarshes ecosystems	✓	×	×	×	✓	×	✓	✓
Fauna	Plankton	×	×	✓	✓	×	×	✓	✓
Fauna	Invertebrates	×	×	✓	✓	×	×	✓	✓
Threatened Species	Fish	×	×	✓	✓	×	×	✓	✓
	Birds	✓	✓	✓	✓	✓	✓	✓	✓
	Marine Reptiles	×	✓	✓	✓	×	✓	✓	✓
	Cetaceans	×	✓	✓	✓	×	✓	✓	✓
	Pinnipeds	✓	✓	✓	✓	✓	✓	✓	✓
Socio-economic	Coastal settlements	✓	×	×	×	✓	×	×	×
	Petroleum exploration and development	×	✓	×	×	×	✓	×	×
	Other infrastructure – none present	–	–	–	–	–	–	–	–
	Defence – none present	–	–	–	–	–	–	–	–
	Shipping	×	✓	×	×	×	✓	×	×
	Tourism	✓	✓	×	×	✓	✓	×	×
	Recreational diving	×	✓	×	✓	×	✓	✓	✓
	Recreational fishing	✓	✓	×	✓	✓	✓	✓	✓
	Commercial fisheries	×	✓	✓	✓	×	✓	✓	✓

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
	Seaweed industry	✓	×	×	✓	✓	×	✓	✓
First Nations	Sea Country	✓	✓	✓	✓	✓	✓	✓	✓
	Native title	✓	×	×	✓	✓	×	✓	✓
	Indigenous Protected Areas	×	×	×	✓	×	×	✓	✓
	Indigenous Land Use Agreements – none present	–	–	–	–	–	–	–	–

6.18.4 Predicted Environmental Impacts

The known and potential environmental impacts of a hydrocarbon spill are:

- Change in water quality

As a result of a change in water quality, further impacts may occur, which include:

- Injury / mortality to fauna
- Change in fauna behaviour
- Change in ecosystem dynamics
- Changes to the functions, interests, or activities of other users

6.18.5 Consequence Evaluation - Diesel

Circumstances resulting in a loss of containment of MDO such as a vessel collision and subsequent fuel tank rupture are low probability events in open ocean areas without restricted navigation. Though shipping activity is relatively high within the operational area, modern navigational aids assist in reducing the likelihood of a collision event. Higher commercial and recreational vessel traffic occurs in and around ports and harbours, which is therefore where the greatest risk of collision occurs. While undertaking the resupply or IMR activities vessels will often be stationary or moving slowly, further reducing the risk of collision with third-party vessels.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2022, Appendix E.2) are detailed in Table 31. The potential environmental impacts to receptors from a diesel spill are discussed in to Table 32 (surface),

Table 33 (shoreline) and Table 34 (in-water) and are based on the spill modelling areas of exposure detailed below.

Potential extent of hydrocarbon exposure to surface waters

The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 39.3 km (east-southeast) during summer conditions, 15.3 km (east-southeast) during winter conditions and 2.7 km (west-southwest) during winter conditions, respectively (Figure 17).

Victorian and Tasmanian waters were not predicted to be exposure to surface oil.

No conservation values or sensitivities were identified to be exposed to surface oil at the low threshold or above.

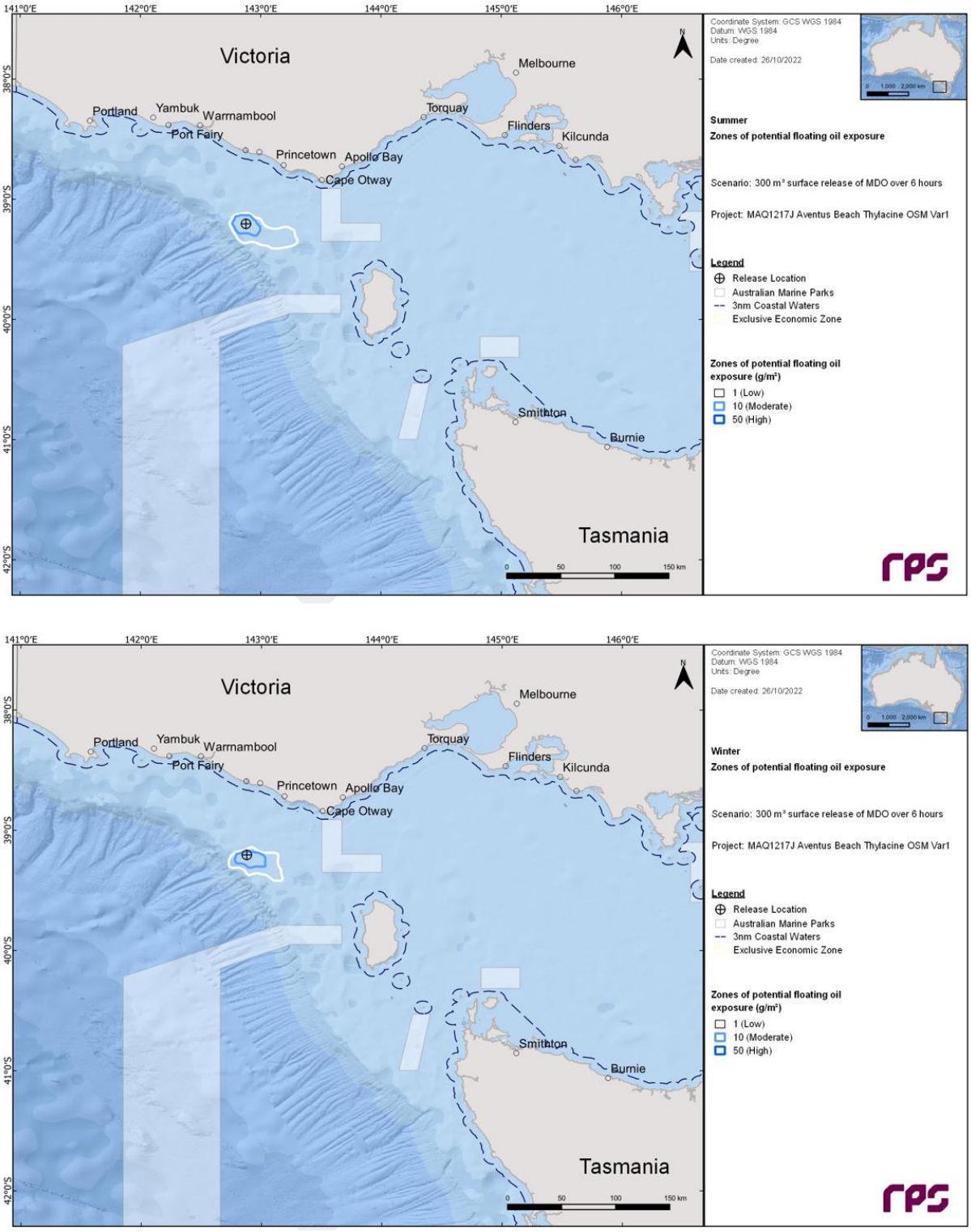

Figure 17: Zones of Potential Surface Oil for 300m^3 Diesel Spill -Summer and Winter

Potential extent of hydrocarbon exposure to shorelines

The probability of accumulation to any shoreline at, or above, the low level (10 g/m2) threshold was 0% during summer conditions and 5% during winter conditions (Figure 18). The minimum time before oil accumulation at, or above, the low threshold was 7.58 days winter conditions. The maximum total

volume ashore for a single spill trajectory during winter conditions was 4.3 m^3, and the maximum length of shoreline accumulation at the low threshold was 11 km. No shoreline accumulation was observed for the summer season nor the moderate or high thresholds for winter.

Shoreline oil at the low threshold had a 4% probability of exposure on the west side of King Island and a 1% probability of exposure at Cape Otway. The minimum time for low threshold shoreline accumulation was 7.58 days for King Island, where the maximum shoreline accumulation (4.3 m^3) also occurred.

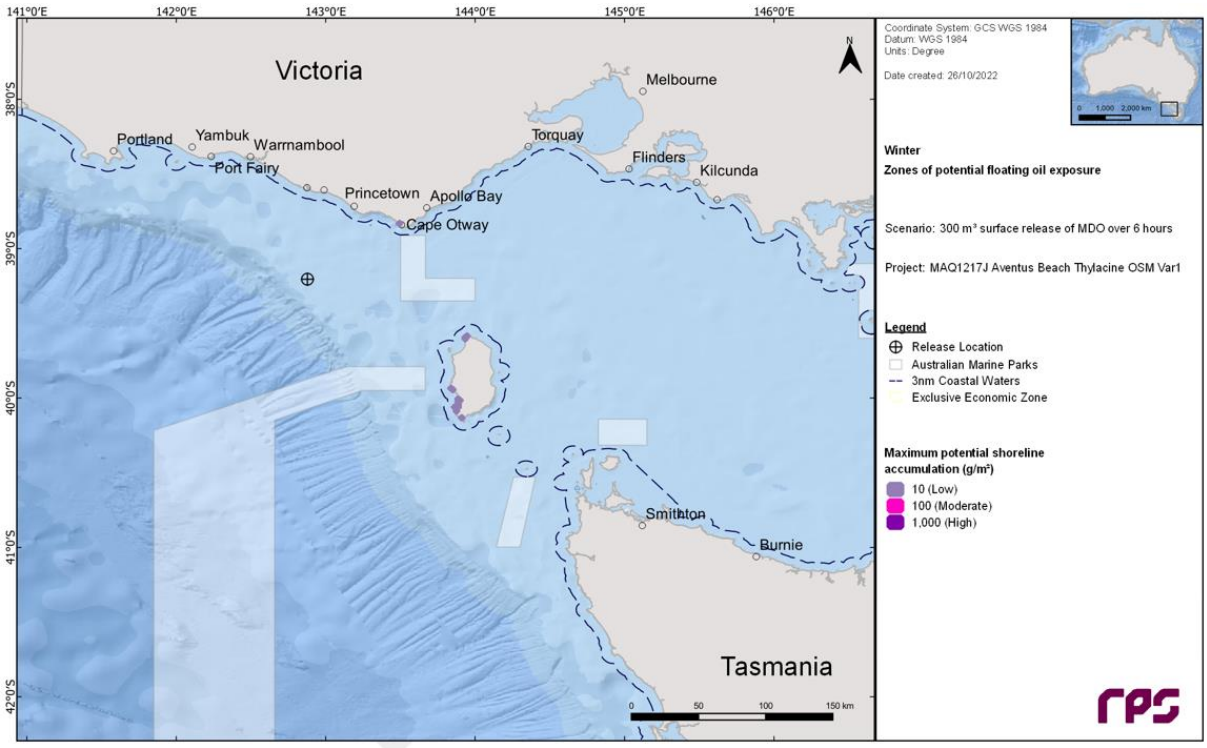

Figure 18: Zones of Potential Shoreline Oil for 300m^3 Diesel Spill -Winter

Potential extent of in-water dissolved hydrocarbon exposure

At the depths of 0-10 m, during the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor was predicted to be 57 ppb and 58 ppb, respectively, which occurred within receptors containing the release location (Figure 19).

There was no predicted exposure to identified receptors at high threshold and a low probability of exposure (maximum 2%) at the moderate threshold.

Victorian and Tasmanian waters were not predicted to be exposed to dissolved hydrocarbons.

The Apollo AMP and the West Tasmania Canyons KEF were predicted to be exposed above the low threshold during both summer and winter conditions.

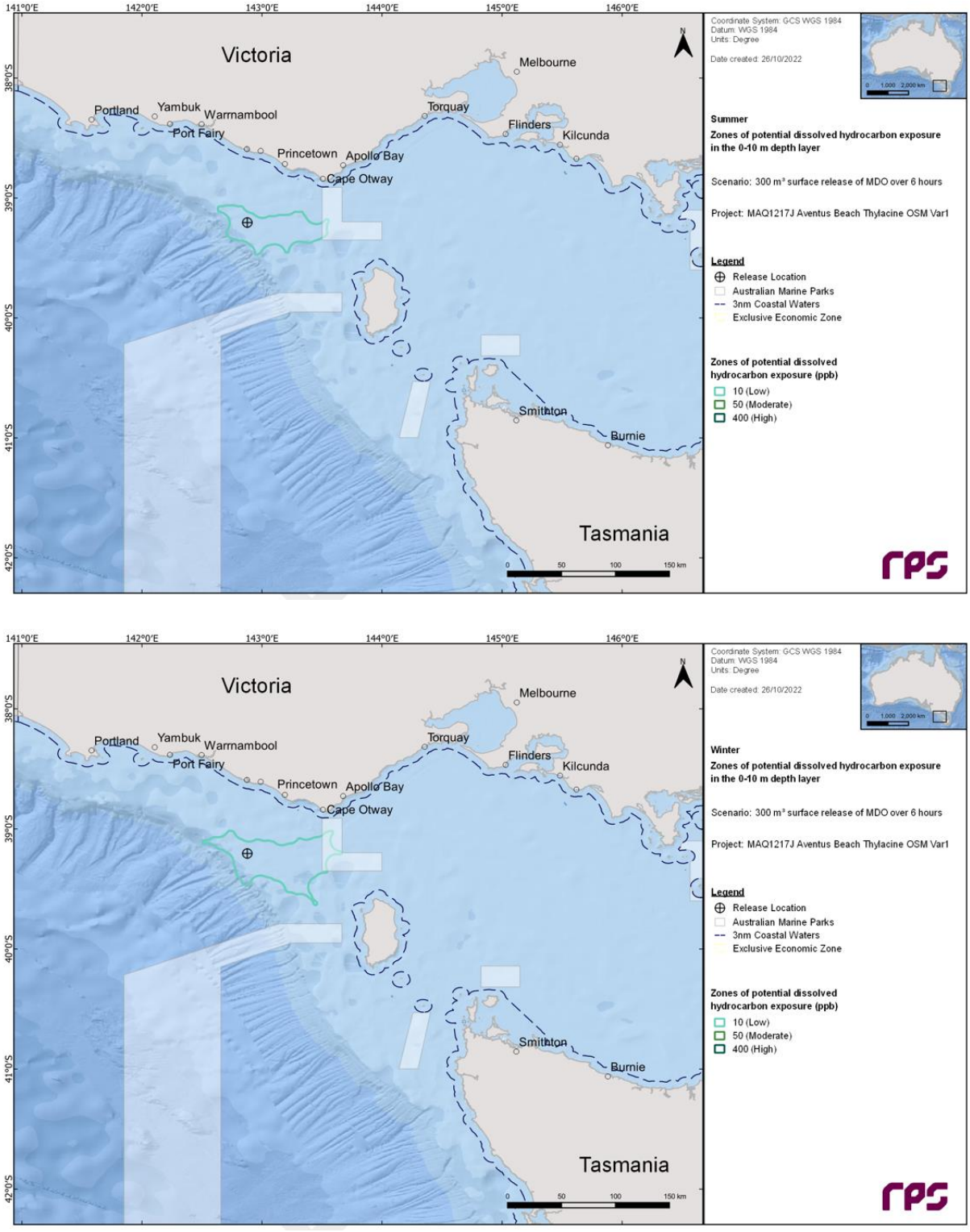

Figure 19: Zones of Potential Dissolved Oil for 300m^3 Diesel Spill -Summer and Winter

Potential extent of in-water entrained hydrocarbon exposure

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure during summer and winter conditions was 6,323 ppb and 7,007 ppb, respectively. Victorian and Tasmanian waters were not

predicted to be exposed to entrained hydrocarbons at the high threshold but had a 14% probability of exposure for Tasmanian waters and a 5% probability for Victorian waters (Figure 20).

The Apollo AMP and West Tasmania Canyons KEF were predicted to be exposed at the high threshold during both summer and winter conditions. While the Zeehan AMP and Twelve Apostles Marine National Park were predicted to be exposed at the low threshold during both summer and winter conditions.

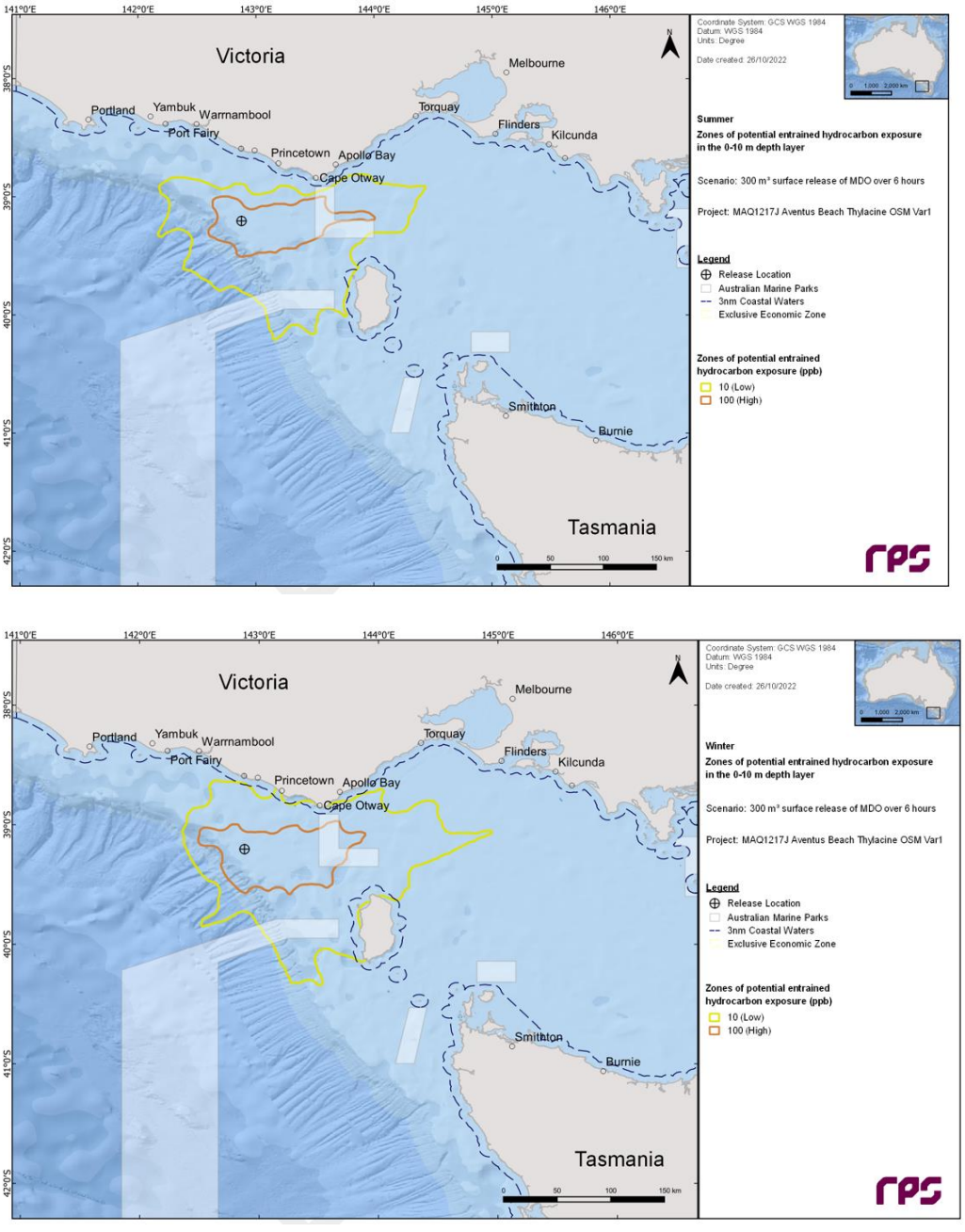

Figure 20: Zones of Potential Entrained Oil for 300m^3 Diesel Spill -Summer and Winter

Table 32: Consequence Evaluation to Receptors – Sea Surface

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Change in fauna behaviour Injury / mortality to fauna	Several listed Threatened, Migratory and/or listed marine species have the potential to be rafting, resting, diving and feeding within 15.3 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel, short-tailed shearwater and wedge-tailed shearwater are present in the area predicted to be above moderate levels of surface hydrocarbons. Foraging and breeding BIAs for little penguins are within the planning area, but not within the predicted area of surface exposure at moderate levels. Colonies of little penguins, without defined BIAs, are known to along parts of Port Campbell Bay area; therefore, it is possible that little penguins may be present in the area exposed to surface hydrocarbon at moderate levels.	When first released, diesel has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of moderate concentrations >10 g/m^2 out to 15.3 km from the release location) may be impacted; however, it is unlikely that many birds will be affected as volatile surface hydrocarbons are expected to evaporate over 3-4 days. Seabirds rafting, resting, diving or feeding at sea have the potential to encounter areas where hydrocarbons concentrations are greater than 10 g/m^2 and due to physical oiling may experience lethal surface concentrations. As such, acute or chronic toxicity impacts (death or long-term poor health) to birds are possible but unlikely for a diesel spill because of the limited period of exposure above 10 g/m^2. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, however, impacts to aggregations may occur. Consequently, the potential consequence to seabirds is considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	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	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

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			BIAs or habitat critical to the survival of the species within this area.	organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing. The number of marine turtles that may be exposed to surface diesel is expected to be low as there are no BIAs or habitat critical to the survival of the species present; however, turtles may be transient within the area of exposure. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, with population impacts not anticipated. Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Pinnipeds (seals and sea lions)	Change in fauna behaviour Injury / mortality to fauna	The Australian and New Zealand fur-seals may occur within the area predicted to be exposed to moderate surface hydrocarbons >10 g/m^2. No BIAs, breading colonies or haul outs areas are within the area of exposure. 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$^{2.}$ 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 consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Cetaceans (whales)	Change in fauna behaviour Injury / mortality to fauna	Several threatened, migratory and/or listed marine species have the potential to be within the area predicted to be exposed to	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

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			moderate surface hydrocarbons of >10 g/m^2.	of an area may displace individuals from important habitat, such as foraging.
			BIAs for foraging for pygmy blue whales and migration for southern right whales are within the area predicted to be exposed to surface hydrocarbons >10 g/m^2.	If whales are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Also, the area exposed by moderate levels of surface hydrocarbons (15.3 km from the release location) is relatively small compared to the overall distribution area of cetaceans. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and known core range for southern right whales, the risk of displacement to whales is considered low. Otway Offshore Operations could occur at any time of year. Therefore, there is potential for interaction with southern right whales given the activity window overlaps with the northern migration period of May-June, the peak breeding (July-August) and southern migration period (September-November). The activity timing overlaps with the blue whale season for migration and foraging in the operational area and planning area. Visual and acoustic surveys suggest that blue whales are present in the Otway region between November to June, peaking in February and March. 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 consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of recognised conservation value.
	Cetaceans (dolphins)	Change in fauna behaviour Injury / mortality to fauna	Several dolphin species have the potential to be within the area predicted to be exposed to moderate surface hydrocarbons of >10 g/m^2. However, there are no BIAs or habitat critical to the survival of the species.	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).

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low. If dolphins are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however due to the short duration of the surface exposure above the impact threshold (approximately 36 hours), this is not likely. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
Socio-economic	Petroleum Exploration and Production	Displacement of other marine users	There are no oil and gas operations or activities within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	No impact predicted as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.
	Shipping	Displacement of other marine users	Shipping occurs within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	Vessels may be present in the area where sea surface oil is present, however, due to the short duration of the surface exposure (approximately 36 hours) deviation of shipping traffic would be unlikely.
	Tourism and recreation (including recreational diving and recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 40 km. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.
	Commercial fisheries	Change in aesthetic value	Commercial fishing occurs within the area predicted to be exposed to	Commercial fishing vessels may be present in the area where sea surface oil is present, however, due to the short duration of the surface exposure (approximately 36 hours) deviation of vessels would be unlikely.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
		Changes to the functions, interests or activities of other users	surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	Impacts to commercial fish and invertebrate species are not predicted from surface oil. A short-term fishing exclusion zone may be implemented. However, given the temporary nature of any surface oil and the low intensity in the area of exposure, there are unlikely to be any significant impact on fisheries in terms of lost catches (and associated income). The relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 40 km. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the areas of Sea Country. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.

Table 33: Consequence Evaluation to Receptors– Shoreline

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	National Heritage Places	Change in aesthetic value **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Ocean Road and Scenic Environs. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Nationally Important Wetlands	Change in aesthetic value Change in ecosystem dynamics **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Aire River/Lower Aire River Wetlands. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The Aire River/Lower Aire River Wetlands consist of three shallow freshwater lakes, brackish to saline marshes and an estuary on the Aire River floodplain. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	State Terrestrial Protected Area	Change in aesthetic value Change in ecosystem dynamics **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Otway National Park and the following on the west side of King Island; Cape Wickham Conservation Area, Cataraqui Point Conservation Area, Seal Rocks State Reserve and Stokes Point Conservations Area. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. However, impacts to fur -seals at the low threshold is not predicted to result impact to this species. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Threatened Ecological Communities Saltmarshes	**Change in ecosystem dynamics**	Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community and Subtropical and Temperate Coastal Saltmarsh may be exposure to shoreline oil at the low threshold. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into these coastal communities at low concentrations which are not predicted to impact their ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
Threatened Species	Pinnipeds (seals and sea lions)	Injury/Mortality to fauna Change in fauna behaviour	The modelling predicts potential shoreline exposure at the low threshold at Seal Rocks on King Island which is a New Zealand fur-seal breeding colony. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Breeding colonies (used to birth and nurse until pups are weaned) are particularly sensitive to hydrocarbon spills (Higgins & Gass, 1993). Pinnipeds are further at risk because of their tendency to stay near established colonies and haul-out areas and consequently are unlikely to practice oil avoidance behaviours. ITOPF (2011a) report that species that rely on fur to regulate their body temperature (such as fur-seals) are the most vulnerable to oil as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil. However, impacts to fur-seals are unlikely at the low thresholds that are predicted for shoreline oil at Seal Rocks. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Socio-economic	Coastal settlements Recreation and tourism (including recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at Cape Otway (Corangamite Shire) and on the west side of King Island. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Shoreline oil at the low threshold had a 4% probability of exposure on the west side of King Island and a 1% probability of exposure at Cape Otway. The minimum time for low threshold shoreline accumulation was 7.58 days for King Island. Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Seaweed industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	The modelling predicts potential shoreline exposure at the low threshold in areas along the west side of King Island where bull kelp is collected.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – North America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. As bull kelp is collected from the shoreline there is a potential for some plants to be affected and not be suitable for collection and processing. However, given the low levels of shoreline oil predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
First Nations	Sea Country Native Title	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at Cape Otway (Eastern Maar native Title claim) and on the west side of King Island. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of Sea Country. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Table 34: Consequence Evaluation to Receptors – In Water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	Australian Marine Parks	Change in values Changes to the functions, interests or activities of other users	Apollo AMP may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column. Zeehan AMP may be exposed to hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The Apollo AMP is located in waters 80 m to 120 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features and the wreck of the MV City of Rayville are not predicted to be impacted. The conservation value of important migration area for blue, fin, sei and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Apollo AMP is an important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these areas of higher hydrocarbon thresholds, meaning there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				The Zeehan AMP is located in waters 50 m to 3,000 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features are not predicted to be impacted. The conservation value of important migration area for blue and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Zeehan AMP is also an important foraging habitat for black-browed, wandering and shy albatrosses, and great-winged and cape petrels. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these areas of higher hydrocarbon thresholds, meaning there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. Consequently, the potential consequence to these AMPS are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	State Marine Protected Areas	Change in values Changes to the functions, interests or activities of other users	The Twelve Apostles Marine National Park may be exposed (1% probability) to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	As impacts are only predicted within 0 – 10 m of the water column values such as the wreck of the Loch Ard, underwater limestone formations of arches and canyons, diverse range of encrusting invertebrates and dive sites are not predicted to be impacted. The unique limestone rock formations, including the Twelve Apostles, marine habitats representative of the Otway marine bioregion and indigenous culture based on spiritual connection to sea country and a history of marine resource use are unlikely to be impacted by entrained hydrocarbons at the low threshold. Consequently, the potential consequence to the Twelve Apostles Marine National Park is considered to be Moderate, as they could be expected to

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				result in localised minor short-term impacts to an area of recognised conservation value.
	Key Ecological Features	Change in ecosystem dynamics	The West Tasmania Canyons KEF may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column.	The West Tasmania Canyons KEF is in water depths > 70 m and thus impacts from in-water hydrocarbons are not predicted.
Ecological	Threatened Ecological Communities	Change in ecosystem dynamics	The Giant Kelp Marine Forests of South East Australia and Subtropical and Temperate Coastal Saltmarsh may be exposed to entrained hydrocarbons at the low threshold within the upper 0 - 10 m of the water column.	Entrained hydrocarbons at the low threshold are not predicted to impact on the ecological function of the Giant Kelp Marine Forests of South East Australia and Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Communities.
Benthic Habitat	Algae	Change in habitat	Video surveys confirmed the presence of high density macroalgae dominated epibenthos in waters shallower than 20 m, however, it is not a dominant habitat feature in eastern Victoria. In-water exposure (dissolved and entrained hydrocarbons) is only predicted to occur within the 0 -10 m of the water column. Macroalgae communities in 20 m water depth are not predicted to be exposed to dissolved hydrocarbons at any threshold or high levels of entrained hydrocarbons at which potential impacts could occur.	NA
	Soft Coral	Change in habitat	Corals do not occur as a dominant habitat type within the planning area, however, their presence has been	NA

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			recorded around areas such as Wilsons Promontory National Park and Cape Otway. In-water exposure (dissolved and entrained hydrocarbons) is only predicted to occur within the 0 -10 m of the water column. Coral communities are not predicted to be exposed to dissolved hydrocarbons at any threshold or high levels of entrained hydrocarbons at which potential impacts could occur.	
	Seagrass	Change in habitat	Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons as seagrass is known to occur within Twelve Apostles Marine Park which has the potential to be exposure to entrained hydrocarbons at the low threshold.	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 that there is no predicted dissolved hydrocarbon exposure and entrained hydrocarbons exposure is only predicted at the low concentrations within the 0 -10 m of the water column, impacts to seagrass is not predicted.
Marine fauna	Plankton	Injury/ Mortality to fauna	Plankton are likely to be exposed to in-water hydrocarbons. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.	Relatively low concentrations of hydrocarbon are toxic to both plankton including zooplankton and ichthyoplankton (fish eggs and larvae). Plankton risk exposure through ingestion, inhalation and dermal contact. Impacts would predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				Once background water quality conditions have re-established, the plankton community may take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, given the limited area exposed by moderate levels of dissolved hydrocarbons, the potential consequence to plankton are considered to be Minor, as they could be expected to result in localised low-level short-term and recoverable impacts.
	Marine invertebrates	Injury/ Mortality to fauna	In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not predicted. Species located in shallow nearshore or intertidal waters may be exposed to in-water hydrocarbons low thresholds. Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to moderate levels of entrained in-water hydrocarbons.	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 consequence to invertebrates, including commercially fished invertebrates are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of value.
	Fish	Injury/ Mortality to fauna	Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Effects will be greatest in the upper 10 m of the water column and areas close to	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

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			the spill source where hydrocarbon concentrations are likely to be highest. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, which is not likely to be exposed). Therefore, any impacts are expected to be highly localised. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the area of exposure, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. Consequently, the potential consequence to fish, including those commercially fished, are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts to species of value. Impacts on fish eggs and larvae entrained in the upper water column are not expected to be significant given the temporary nature of the resulting change in water quality. As egg/larvae dispersal is widely distributed in the upper layers of the water column it is expected that current induced drift will rapidly replace any oil affected populations. Consequently, the potential consequence to eggs/larva are considered to be Minor, as they could be expected to result in localised low-level short-term impacts.
	Pinnipeds (seals and sea lions)	Injury/ Mortality to fauna Change in fauna behaviour	Australian and New Zealand fur-seals may occur within the area of exposure. There are no identified BIAs for seals or sea lions within the area of exposure. No known breeding colonies of Australian or New Zealand fur-seals are exposed to moderate dissolved or high entrained exposure thresholds. Given the mobility of pinnipeds, there may be small numbers of seals in the areas predicted to be temporarily exposed to moderate dissolved or high	Exposure to moderate dissolved or high entrained exposure thresholds in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Due to the temporary and localised nature of the spill, pinnipeds widespread nature, the low-level exposure zones and rapid loss of the volatile components of diesel in choppy and windy seas (such as that of the area exposed), the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 - 10 m of the water column.	
	Cetaceans (whales and dolphins)	Injury/ Mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the area predicted to be exposed to in-water hydrocarbons. BIAs for foraging for pygmy blue whales and the known core range for southern right whales are within the area predicted to be exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 - 10 m of the water column.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the MDO weathers. The potential for impacts to cetaceans and dolphins would be limited to a relatively short period following the release and would need to coincide with seasonal foraging or aggregation event to result in exposure to a large number of individuals, as may be the case during seasonal upwelling events within the Otway region. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and known core range for southern right whales. Consequently, the potential consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
Socio-economic	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk	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.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the planning area and overlap the spatial extent of the water column hydrocarbon predictions.	Consequently, the potential consequence to commercial and recreational fisheries are considered to be Minor, as they could be expected to result in localised low-level short-term impacts.
	Recreation and tourism	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Tourism and recreation are also linked to the presence of marine fauna (e.g. whales), particular habitats and locations for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds 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	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, impacts would be localised and for a relatively short duration. Consequently, the potential consequence to recreation and tourism are considered to be Moderate, as they could be expected to result in localised short-term impacts.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			dependent on how long the attraction remains closed.	
	Seaweed Industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to entrained diesel may result in a reduction in commercially targeted seaweed species. Areas along the west side of King Island where bull kelp is collected may be exposed to entrained hydrocarbons at the low threshold within the upper 0 - 10 m of the water column.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – north America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. The study did not look at how this would affect the productivity of bull kelp. However, given the low levels of entrained hydrocarbons predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title Indigenous Protected Area	Change in aesthetic value Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons is predicted along the Victorian and Tasmanian coastal waters within the planning area which is Sea Country for a number of First Nations groups and is adjacent to the Eastern Maar Native Title claim and Preminghana Indigenous Protected Area.	The connection First Nations people have to Sea Country which could be potentially impacted by in-water exposure to hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

6.18.6 Control Measures, ALARP and Acceptability Assessment – Diesel Spill

Control, ALARP and acceptability assessment: Loss of Containment - diesel	
ALARP decision context and justification	ALARP Decision Context: Type B Vessels have been used for activities within the Otway Offshore Development including operations for over a decade with no major incident. Vessel activities are well regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these events. However, if a diesel spill occurred from a vessel collision this could attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
CM#14: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Office (AHO) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue radio-navigation warnings. Relevant details in relation to the vessel activity will be provided to the AHO and AMSA and to relevant stakeholders to ensure the presence of the vessel is known in the area.
	Under the *OPGGS Act 2006* there is provision for ensuring that petroleum activities are carried out in a manner that doesn't interfere with other marine users to a greater extent than is necessary or the reasonable exercise of the rights and performance of the duties of the titleholder. Beach ensures this is achieved by conducting suitable consultation with relevant stakeholders. Consultation with potentially affected fisheries ensures the risk of interaction with these users is limited.
CM#30: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a Shipboard Marine Pollution Emergency Plan (SMPEP) or Shipboard Oil Pollution Emergency Plan (SOPEP) (according to class) is required to be developed based upon the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. To prepare for a spill event, the SMPEP/SOPEP details: • Response equipment available to control a spill event. • Review cycle to ensure that the SMPEP/SOPEP is kept up to date. • Testing requirements, including the frequency and nature of these tests. • In the event of a spill, the SMPEP/SOPEP details: • Reporting requirements and a list of authorities to be contacted. • Activities to be undertaken to control the discharge of hydrocarbon. • Procedures for coordinating with local officials. Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
CM#33: MO 21: Safety and emergency arrangements	AMSA MO 21: Safety and emergency arrangements gives effect to SOLAS regulations dealing with life-saving appliances and arrangements, safety of navigation and special measures to enhance maritime safety.
CM#18: MO 30: Prevention of collisions	AMSA MO 30: Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.

CM#34: MO 31: SOLAS and non-SOLAS certification	All vessels contracted to Beach will have in date certification in accordance with AMSA MO 31: SOLAS and non-SOLAS certification
CM#19: MO 27: Safety of navigation and radio equipment	AMSA MO 27: Safety of navigation and radio equipment gives effect to SOLAS regulations regarding radiocommunication and safety of navigation and provides for navigation safety measures and equipment and radio equipment requirements.
CM#35: Vessel fuel type	Vessels contracted to conduct activities under this EP will only carry marine diesel.

Additional controls assessed

Control	Control Type	Cost/Benefit Analysis	Control Implemented?
Eliminate or substitute the use of diesel.	Equipment	The use of diesel for fuel for vessels and machinery cannot be eliminated. Substituting for another fuel, i.e. Heavy Fuel Oil or bunker fuel oil, would have a higher environmental impact than diesel.	No

Consequence rating	Moderate (2)
Likelihood of occurrence	Highly Unlikely (2) based upon AMSA Annual Report 2017-18 (serious incident reports)
Residual risk	Medium
Acceptability Assessment	
To meet the principles of ESD	The risk of a loss of containment resulting in a diesel spill was assessed as medium and the highest consequence assessed as moderate which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	No objections or claims have been raised during stakeholder consultation regarding the potential for diesel spills.
Other Requirements	• Vessel activities undertaken during Otway Offshore Operations will adhere to relevant legislative requirements as detailed in the controls section. • The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP 2013) identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure or source of pressure on the conservation values of the South-east Marine Reserves Network. The Apollo AMP may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column and the Zeehan AMP may be exposed to hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Impacts to these AMP major conservation values are assessed as short-term and recoverable based on the majority of the exposure being to dissolved hydrocarbons for a short period of time. Impacts to AMP major conservation values for ecosystems, habitats, communities and cultural and heritage sites are not predicted as in-water hydrocarbons are only predicted within 0 – 10 m of the water column which does not intersect with these values. • The following Conservation Advices / Recovery Plans identify pollution as a key threat:

	◦ Recovery Plan for Marine Turtles in Australia (CoA, 2017b), identified as acute chemical discharge (oil pollution) ◦ Conservation Advice for *Sterna nereis nereis* (Australian fairy tern) (DSEWPaC, 2011b) ◦ National Recovery Plan for the Australian Painted Snipe (CoA, 2022) identified as a deterioration of water quality ◦ Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015c) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) ◦ National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022) ◦ Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015d) ◦ Wildlife Conservation Plan for Seabirds (CoA, 2020a) • These Conservation Advices and Recovery Plan identify the following conservation actions: ◦ Minimise chemical and terrestrial discharge. Controls have been identified and will be implemented to minimise the risk of minimise chemical discharges. ◦ Ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. No habitats for turtles are identified within the diesel planning area. OPEP and OSMP cover management of response to oiled turtles. ◦ Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. OPEP and OSMP cover response strategies for management breeding sites vulnerable to oil spills. ◦ Implement measures to reduce adverse impacts of habitat degradation and/or modification. Controls have been identified and will be implemented to reduce adverse impacts of habitat degradation and/or modification.
Monitoring and reporting	Loss of containment resulting in a diesel spill is required to be reported as per the EP. Impacts as a result of a loss of containment resulting in a diesel spill will be monitored and reported in accordance with the OSMP.
Acceptability outcome	**Acceptable**

6.18.7 Consequence Evaluation - Condensate

Circumstances resulting in a loss of containment of condensate from the Otway Gas Pipeline, subsea wells and infrastructure or Thylacine-A Wellhead Platform are low probability events.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2023, Appendix E.1) are detailed in Table 31. The potential environmental impacts to receptors from a diesel spill are discussed in to Table 36 (surface), Table 37

(shoreline) and Table 38 (in-water) and are based on the spill modelling areas of exposure detailed below.

Potential extent of hydrocarbon exposure to surface waters

The maximum distance from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 44.5 km (southeast) during summer conditions and 0.4 km (south) during winter conditions, respectively (Figure 21). No floating oil exposure above the high (> 50 g/m2) threshold was predicted by the modelling.

Floating oil exposure above the low threshold was predicted at the West Tasmania Canyons KEF (2%) during summer only. No other conservation values or sensitivities were exposed to surface oil above threshold levels.

No Victorian or Tasmania waters were exposed to surface oil above threshold levels.

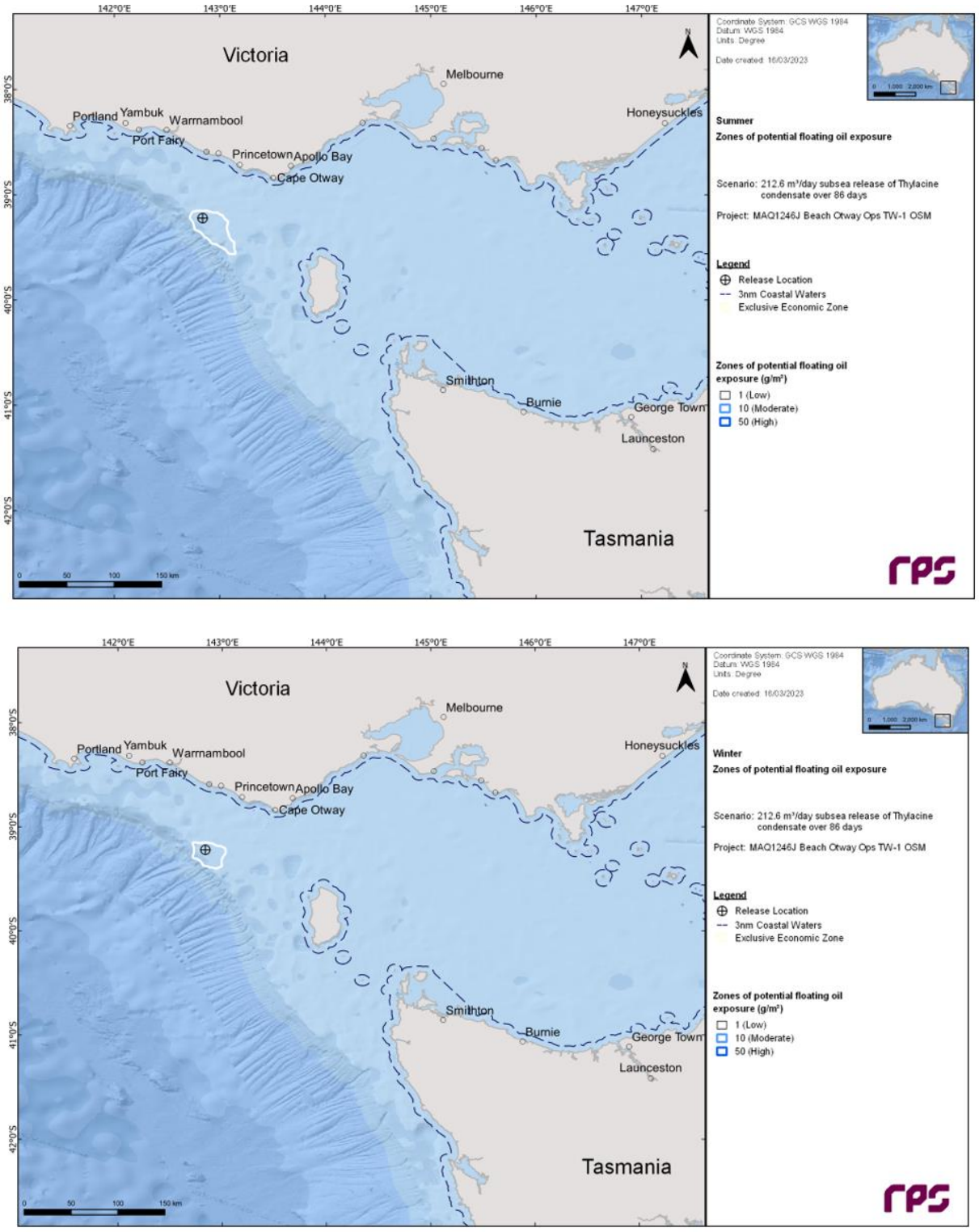

Figure 21: Zones of Potential Surface Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

Potential extent of hydrocarbon exposure to shorelines

The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 41% during summer conditions and 75% during winter conditions (Figure 22). The minimum time before oil accumulation at, or above, the low threshold was 13 days during summer conditions, and 6.54 days during winter conditions.

The maximum volume ashore for a single spill trajectory during the summer and winter conditions was 11.6 m^3 and 16.6 m^3, respectively, whilst the maximum length of shoreline accumulation at the low threshold was 18.9 km and 28.9 km, respectively.

No shoreline accumulation was predicted for the moderate (100 g/m^2) or high (1,000 g/m^2) threshold.

King Island recorded the highest probability of shoreline accumulation at the low threshold with 39% (summer) and 65% (winter) and the largest shoreline accumulation with 17.2 m^3 and 11.7 m^3, respectively.

The minimum time before shoreline accumulation above the low threshold was 13 days predicted for King Island during summer conditions and 6.54 days during the winter conditions predicted for Colac Otway West sub-Local Government Area (LGA) (which is part of Colac Otway West LGA) (Table 35).

Table 35: Summary of Shoreline Oil Accumulation on Local Government Areas

	Shoreline Receptor	Summer																		Winter											
		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)			Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA	Circular Head	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	33.00	-	-	< 1	20	0.4	2.3	1.7	-	-	3	-	-
	Colac Otway	9	-	-	23.38	-	-	< 1	47	0.4	3.3	3.4	-	-	7.1	-	-	15	-	-	6.54	-	-	1	39	0.6	3.2	2.9	-	-	8.1	-	-
	Corangamite	4	-	-	50.13	-	-	< 1	14	0.2	1.2	1.5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	39.29	-	-	< 1	14	0.6	1.1	1	-	-	1	-	-
	Glennie Group	1	-	-	95.38	-	-	< 1	13	< 0.1	0.4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	King Island	39	-	-	13.00	-	-	2	67	2	7.4	5.8	-	-	17.2	-	-	65	-	-	6.92	-	-	3	96	3.7	11.7	9.7	-	-	27.3	-	-
	Moyne	2	-	-	65.50	-	-	< 1	11	0.1	0.6	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Phillip Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	25.83	-	-	< 1	12	0.1	0.5	1	-	-	1	-	-
	South Gippsland	3	-	-	60.88	-	-	< 1	14	0.3	1.5	1.7	-	-	2	-	-	8	-	-	26.75	-	-	1	19	0.5	1.9	1.9	-	-	3	-	-

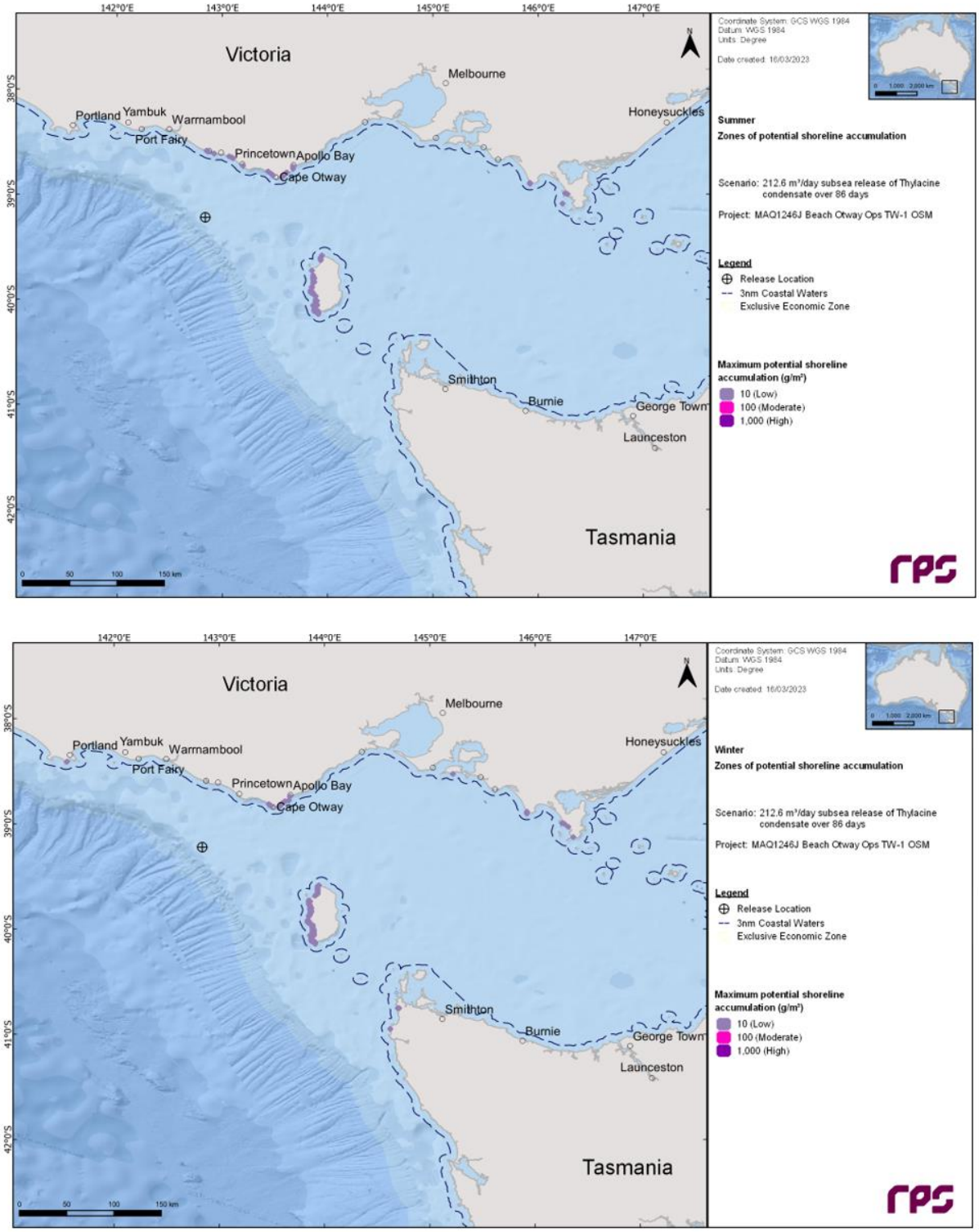

Figure 22: Zones of Potential Shoreline Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

Potential extent of in-water dissolved hydrocarbon exposure

At the depths of 0-10 m, during the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor was predicted to be 686.4 ppb and 664.658 ppb, respectively, which occurred within the release location (Figure 23).

Victorian waters were predicted to be exposed to dissolved hydrocarbons at the low threshold (5% summer and 10% winter) and at the moderate threshold for winter only (1%).

Tasmanian waters were predicted to be exposed to dissolved hydrocarbons at the low threshold (36% summer and 48% winter) and at the moderate threshold (2% summer and 3% winter).

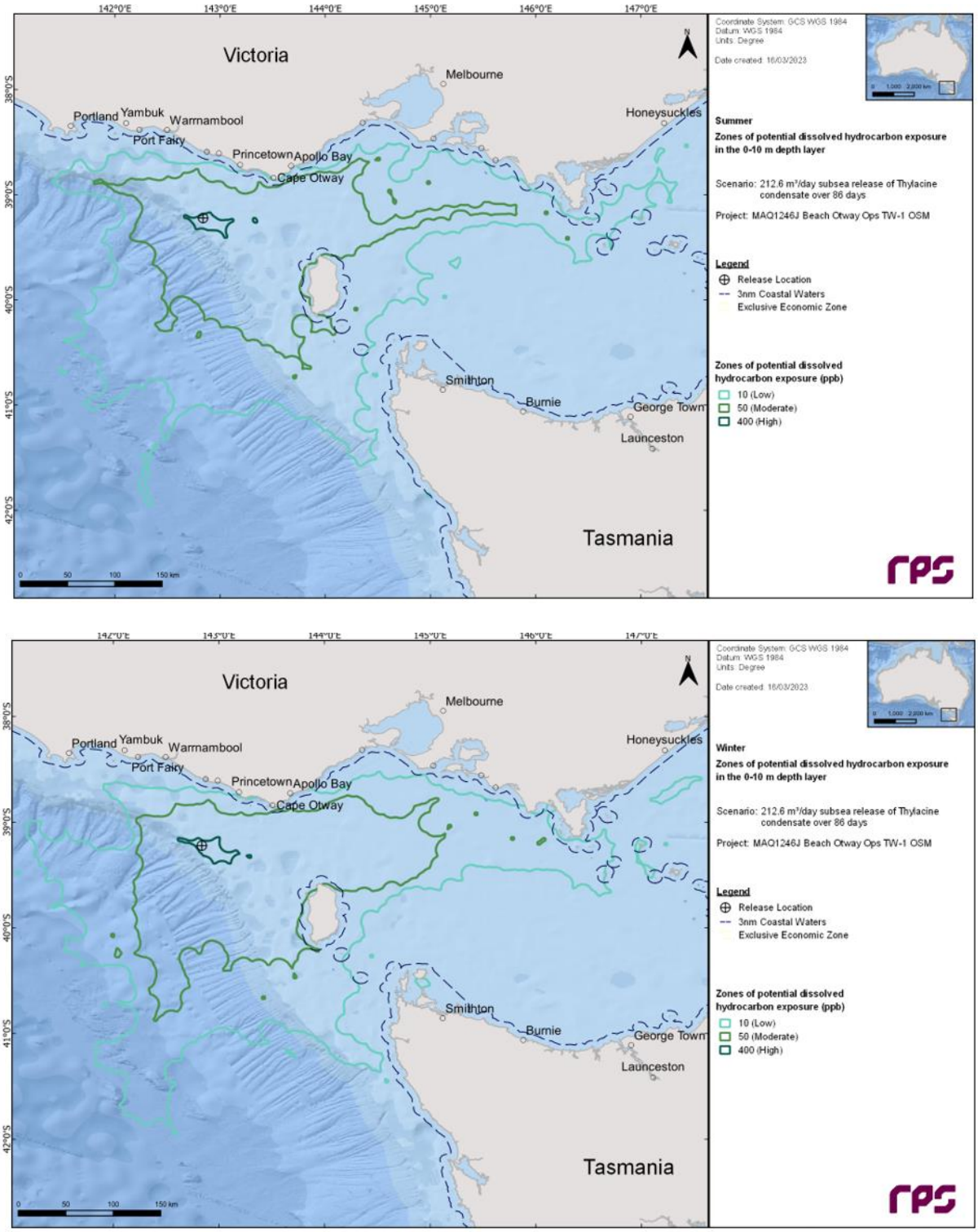

Figure 23: Zones of Potential Dissolved Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

Potential extent of in-water entrained hydrocarbon exposure

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure during summer and winter conditions was 927.6 ppb and 1,000.9 ppb, respectively, which occurred within the release location (Figure 24).

Victorian waters were predicted to be exposed to entrained hydrocarbons only at the low threshold (8% summer and 27% winter).

Tasmanian waters were predicted to be exposed to entrained hydrocarbons only at the low threshold (54% summer and 62% winter).

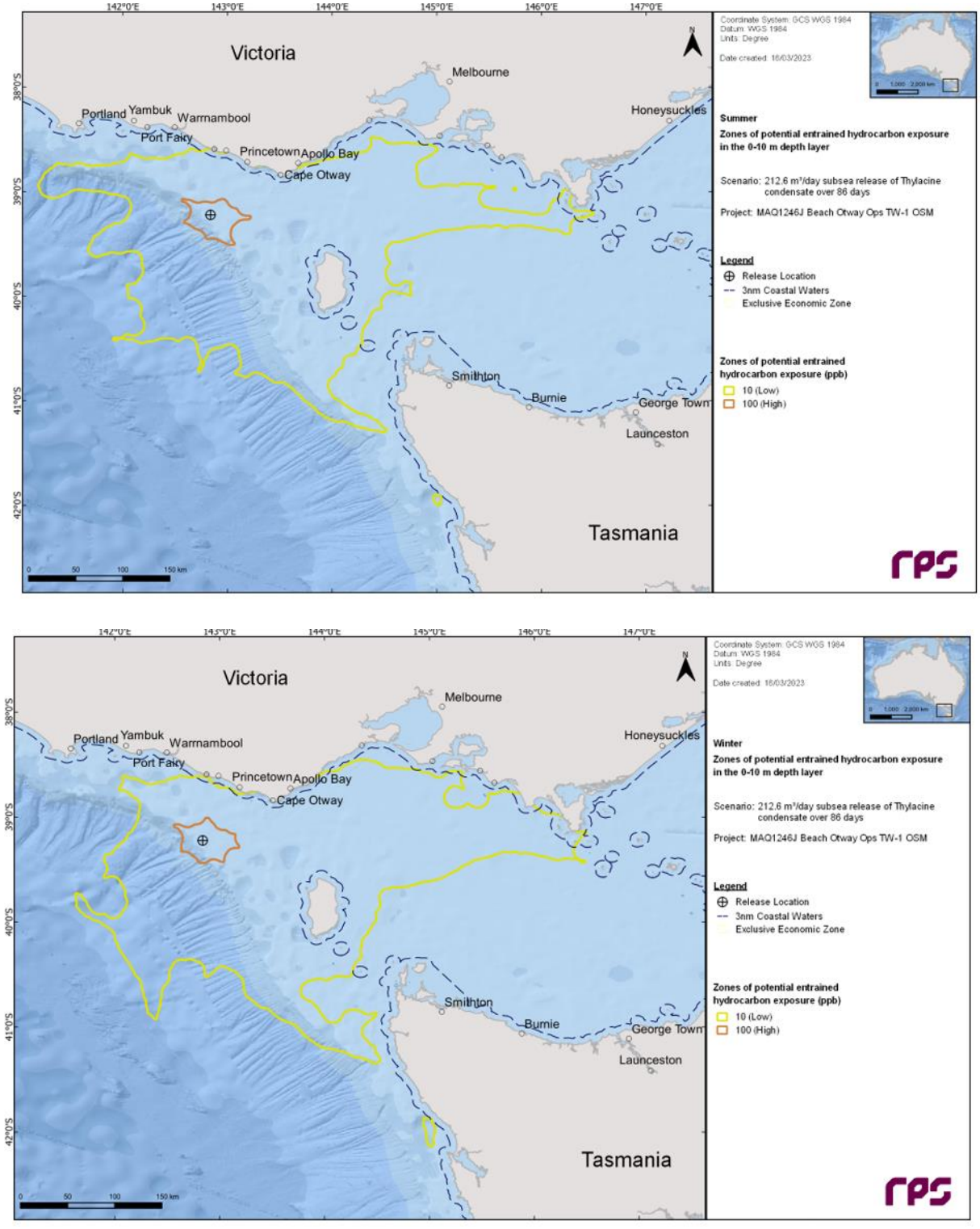

Figure 24: Zones of Potential Entrained Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

Table 36: Consequence Evaluation to Receptors – Sea Surface

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Injury / mortality to fauna Change in fauna behaviour	Several listed Threatened, Migratory and/or Listed Marine species have the potential to be rafting, resting, diving or feeding within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater and wedge-tailed shearwater within the area predicted to be exposed to moderate thresholds of surface oil.	When first released, gas condensate has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of concentrations >10g /m^2 out to 0.4 km from the release location) may suffer impacts however it is unlikely that a large number of birds will be affected. Exposure at the high threshold (>25 g/m^2) were not predicted. Seabirds exposed to surface hydrocarbons at moderate exposure levels may experience acute or chronic toxicity impacts, however the area of contact is localised (0.4 km) and the presence of birds is expected to be limited to foraging individuals of a transitory nature, given the absence of offshore aggregation areas and the large foraging BIAs. Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Marine reptiles	Injury / mortality to fauna Change in fauna behaviour	There may be transiting marine turtles within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. However, there are no BIAs or habitat critical to the survival of the species within the area predicted to be exposed to moderate thresholds of surface oil.	Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing. The number of marine turtles that may be exposed to surface condensate is expected to be low as there are no BIAs or habitat critical to the survival of the species present and the localised (0.4 km from the release location) extent of exposure above the 10 g/m^2 threshold; however, turtles may be transient within the area. Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	The Australian and New Zealand fur-seals may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. No BIAs, breading colonies or haul outs areas within the area predicted to be exposed to moderate thresholds of surface oil.	Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Fur seals are particularly vulnerable to hypothermia from oiling of their fur – however the characteristics of Thylacine condensate mean this is not likely. The number of pinnipeds exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Cetaceans (whales)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine species have the potential to be foraging within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. The area of exposure overlaps a foraging BIA for pygmy blue whales and the migration BIA for southern right whale.	Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may displace individuals or aggregations from important habitat, such as foraging. If whales are foraging at the time of the spill, a greater number of individuals may be present in the plume, however due to the small area of the surface exposure above the impact threshold (0.4 km from release location), this is not likely. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and known core range for southern right whales, the risk of displacement to whales is considered low. Otway Offshore Operations could occur at any time of year. Therefore, there is potential for interaction with southern right whales given the activity window overlaps with the northern

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				migration period of May-June, the peak breeding (July-August) and southern migration period (September-November). The activity timing overlaps with the blue whale season for migration and foraging. Visual and acoustic surveys suggest that blue whales are present in the Otway region between November to June, peaking in February and March. As such in the event of a spill potential hydrocarbon exposure could possibly affect blue or other foraging whale species. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Cetaceans (dolphins)	Injury / mortality to fauna Change in fauna behaviour	There may be dolphins within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. However, it is not identified as critical habitat, and there are no spatially defined aggregations within the area predicted to be exposed to moderate thresholds of surface oil.	Dolphins surface to breathe air and may inhale hydrocarbon vapours or be directly exposed to dermal contact with surface hydrocarbons. Direct contact with oil can result in direct impacts to the animal, due to toxic effects if ingested, damage to lungs when inhaled at the surface, and damage to the skin and associated functions such as thermoregulation (AMSA 2010). Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Socio-economic	Petroleum Exploration and Production	Displacement of other marine users	There are no oil and gas platforms, or activities within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	No impact predicted as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.
	Shipping	Displacement of other marine users	Shipping may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	Vessels may be present in the area where moderate levels of sea surface oil are predicted, however, due to small area of exposure (0.4 km) the area of deviation is small and within the existing PSZs, and no impact is predicted.
	Tourism and recreation (including recreational diving and recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 44.5 km in summer and 20.6 km in winter. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration and distance from shore means there may be short-term and localised consequences, which are ranked as Moderate.
	Commercial fisheries	Displacement of other marine users	Commercial fishing may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	Commercial fishing vessels may be present in the area where moderate levels of sea surface oil are predicted, however, due to small area of exposure (0.4 km) the area of deviation is small and within the existing PSZs, and no impact is predicted.
First Nations	Sea Country	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 44.5 km in summer and 20.6 km in winter. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the areas of Sea Country. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.

Table 37: Consequence Evaluation to Receptors – Shorelines

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	National Heritage Places	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Ocean Road and Scenic Environs and Western Tasmania Aboriginal Cultural Landscape. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach the Otway coast where the Great Ocean Road and Scenic Environs is 6.58 days and 33 days for the coast where the where the Western Tasmania Aboriginal Cultural Landscape is located. The relatively short are of shoreline affected and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Nationally Important Wetlands	Change in aesthetic value Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Aire River/Lower Aire River, Princetown and Western Post Wetlands. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach the shoreline adjacent to the River/Lower Aire River and Princetown Wetlands is 6.54 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The Aire River/Lower Aire River Wetlands consist of three shallow freshwater lakes, brackish to saline marshes and an estuary on the Aire River floodplain. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The Princetown Wetlands and upstream of the Gellibrand River mouth at Princetown Beach. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				which are not predicted to impact the aesthetic and ecological value of the wetlands. Shoreline exposure of 1% during winter is predicted for Phillip Island which is within the Western Port Wetland. Minimum time for shoreline accumulation is 25.83 days. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	State Terrestrial Protected Area	Change in aesthetic value Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Otway National Park, Phillip Island Nature Park, Port Campbell Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks, and the following on the west side of King Island; Cape Wickham Conservation Area, Cataraqui Point Conservation Area, Porky Beach Conservation Area, Seal Rocks State Reserve, Stokes Point Conservations Area and West Point State Reserve. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 6.54 for the Victorian coast and it is likely to have dissipated during that time due to substantial wave action that would further breakdown any shoreline hydrocarbons. The predicted minimum time for oil to reach a King Island is 6.92 days it is likely to have dissipated during that time due to substantial wave action that would further breakdown any shoreline hydrocarbons. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. However, impacts to fur -seals at the low threshold is not predicted to result impact to this species. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Threatened Ecological Communities Saltmarsh	Change in habitat Change in ecosystem dynamics	The modelling predicts potential shoreline exposure at the low threshold where saltmarsh communities and the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community and Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Communities may be present. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Saltmarshes are considered to have a high sensitivity to hydrocarbon exposure. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil. Evidence from case histories and experiments shows that the damage resulting from oiling, and recovery times of oiled marsh vegetation, are very variable. In areas of light to moderate oiling where oil is mainly on perennial vegetation with little penetration of sediment, the shoots of the plants may be killed but recovery can take place from the underground systems. Good recovery commonly occurs within one to two years (IPIECA, 1994). Consequently, the potential consequences to saltmarsh exposed to low threshold shoreline hydrocarbons is considered to be Moderate, as they could be expected to short-term and localised.
Threatened Species	Seabirds and shorebirds Pinnipeds	Injury / mortality to fauna Change in fauna behaviour	Impacts to birds and pinnipeds are not predicted as shoreline oil exposure is not predicted at the moderate threshold where impacts to fauna may occur.	NA

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Socio-economic	Coastal settlements Recreation and tourism (including recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at the following local government areas (LGA): • Circular Head • Colac Otway • Corangamite • Glennie Group • King Island • Moyne • Phillip Island • South Gippsland The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 6.54 days (Colac Otway) up to 95 days (Glennie Group) and it is likely to have dissipated during that time due to substantial wave action that would breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Seaweed industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	The modelling predicts potential shoreline exposure at the low threshold in areas along the west side of King Island where bull kelp is collected.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – North America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. As bull kelp is collected from the shoreline there is a potential for some plants to be affected and not be suitable for collection and processing. However, given the low levels of shoreline oil predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold within Victorian Traditional Owner areas of Eastern Maar Aboriginal Corporation (and Native Title claim) and Bunurong Land Council Aboriginal Corporation. The modelling predicts shoreline exposure at the low threshold on the western side of King Island and two locations within the north-west coast of Tasmania. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of Sea Country. The predicted minimum time for oil to reach a shoreline is 6.54 days for the Victorian coast, 6.92 days for King Island and 33 days for north-west Tasmania and it is likely to have dissipated during that time due to substantial wave action that would breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Table 38: Consequence Evaluation to Receptors – In Water

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	Australian Marine Parks	Change in values Changes to the functions, interests or activities of other users	Apollo and Zeehan AMPs may be exposed to dissolved hydrocarbons at the moderate threshold and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Beagle AMP may be exposed to dissolved hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Franklin AMP may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The Apollo AMP is located in waters 80 m to 120 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features and the wreck of the MV City of Rayville are not predicted to be impacted. The conservation value of important migration area for blue, fin, sei and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Apollo AMP is an important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in the hydrocarbon exposed area, thus there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The Zeehan AMP is located in waters 50 m to 3,000 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features are not predicted to be impacted. The conservation value of important migration area for blue and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				10 m of the water column for a substantial period to elicit a toxic effect. The Zeehan AMP is also an important foraging habitat for black-browed, wandering and shy albatrosses, and great-winged and cape petrels. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these areas of hydrocarbon exposure, thus there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The Beagle AMP is located in waters 50 m to 70 m water depth and thus conservation values such as ecosystems, habitats and communities associated with the Southeast Shelf Transition and associated with the seafloor features, and shipwrecks are not predicted to be impacted. The Beagle AMP is also an important migration and resting areas for southern right whales and provides important foraging habitat for the Australian fur-seal, killer whale, great white shark, shy albatross, Australasian gannet, short-tailed shearwater, Pacific and silver gulls, crested tern, common diving petrel, fairy prion, black-faced cormorant and little penguin. These species are not precited to be impacted at the low thresholds for dissolved hydrocarbons. The Franklin AMP is located in waters 40 m to 150 m water depth and thus conservation values such as ecosystems, habitats and communities associated with the Tasmanian Shelf Province, Western Bass Strait Shelf Transition and associated with sea-floor features are not predicted to be impacted. The Franklin AMP is also an important foraging area for shy albatross, short-tailed shearwater, Australasian gannet,

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				fairy prion, little penguin, common diving petrel, black-faced cormorant, and silver gull. These species are not predicted to be impacted at the low thresholds for dissolved and entrained hydrocarbons. Consequently, the potential consequence to these AMPS are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	State Marine Protected Areas	Change in values Changes to the functions, interests or activities of other users	Shallow Inlet Marine and Coastal Park, Twelve Apostles Marine National Park and Wilsons Promontory Marine National Park may be exposed (1% probability) to dissolved hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Twelve Apostles Marine National Park (3% probability), Wilsons Promontory Marine National Park (7% probability) and Wilsons Promontory Marine Park (1% probability) may be exposed to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The establishment of the Shallow Inlet Marine and Coastal Park was primarily in recognition of its high value as habitat for migratory waders and other shorebirds. These species are not predicted to be impacted at the low thresholds for dissolved hydrocarbons. Impacts to Wilsons Promontory Marine National Park and Wilsons Promontory Marine Park values such as abundant and diverse marine flora and fauna, important breeding sites for a significant colony of Australian fur seals, important habitat for several threatened shorebird species, including species listed under international migratory bird agreements, outstanding landscapes, seascapes and spectacular underwater scenery, seascape, cultural places and objects of high traditional and cultural significance to Indigenous people, Indigenous cultural lore and interest maintained by the Gunai / Kurnai and Boonwurrung people and important maritime and other history, are not predicted to be impacted by low threshold level of entrained and dissolved hydrocarbons. As impacts are only predicted within 0 – 10 m of the water column Twelve Apostles Marine National Park values such as the wreck of the Loch Ard, underwater limestone formations of arches and canyons, diverse range of

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				encrusting invertebrates and dive sites are not predicted to be impacted. The unique limestone rock formations, including the Twelve Apostles, marine habitats representative of the Otway marine bioregion and indigenous culture based on spiritual connection to sea country and a history of marine resource use are unlikely to be impacted by dissolved or entrained hydrocarbons at the low threshold. Consequently, the potential consequence to these State Marine Protected Areas is considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	Key Ecological Features	Change in ecosystem dynamics	The West Tasmania Canyons KEF may be exposed to dissolved hydrocarbons at the low and moderate threshold and entrained hydrocarbons at the low and high threshold within the upper 0 -10 m of the water column.	The West Tasmania Canyons KEF is in water depths > 70 m and thus impacts from in-water hydrocarbons are not predicted.
	Threatened Ecological Communities	Change in ecosystem dynamics	The following Threatened Ecological Communities may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community. Giant Kelp Marine Forests of South East Australia. Subtropical and Temperate Coastal Saltmarsh.	Entrained hydrocarbons at the low threshold are not predicted to impact on the ecological function of the Threatened Ecological Communities.
Benthic Habitat	Algae	Change in habitat	Video surveys confirmed the presence of high density macroalgae dominated epibenthos in waters shallower than 20 m, however, it is not a dominant habitat feature in eastern Victoria (Section 4.4.1.3).	Reported toxic responses to oils have included a variety of physiological changes to enzyme systems, photosynthesis, respiration, and nucleic acid synthesis (Lewis & Pryor 2013). A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			Dissolved hydrocarbons in the upper 0 – 10 m of the water column at the moderate threshold that could impact algae, have a 3% probability for exposure to Tasmanian waters and 1% for Victorian waters where waters may be shallower than 10 m. Entrained hydrocarbons in the upper 0 – 10 m of the water column at the high threshold that could impact algae are not predicted in Tasmanian waters or Victorian waters where waters may be shallower than 10 m.	variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and only the predicted moderate threshold concentrations of dissolved hydrocarbons predicted in shallow waters, any impact to algae is not expected to result in long-term or irreversible damage. Consequently, the potential consequence to algae are considered to be Minor, as they could be expected to result in localised low-level impacts.
	Soft Coral	Change in habitat	Corals do not occur as a dominant habitat type within the planning area, however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway where low threshold concentrations of dissolved or entrained hydrocarbons are predicted.	Exposure of entrained hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate to high exposure thresholds (Shigenaka, 2001). Contact with corals may lead to reduced growth rates, tissue decomposition, and poor resistance and mortality of sections of reef (NOAA, 2010). However, given the lack of coral reef formations, and the sporadic cover of hard or soft corals in mixed nearshore reef communities along the Otway coast, such impacts are considered to be limited to isolated corals. Also only low exposure thresholds are predicted at known coral habitat sites. Consequently, the potential consequence to algae are considered to be Minor, as they could be expected to result in localised low-level impacts.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Seagrass	Change in habitat	In-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 – 10 m of the water column; therefore, benthic habitat within intertidal or shallow nearshore waters has the potential to be exposed. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the condensate. Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons (e.g. seagrass is known to occur within Twelve Apostles Marine Park, and areas around Warrnambool). Exposure in nearshore and intertidal areas is predicted to only be at a low thresholds for dissolved and entrained hydrocarbons.	There is the potential that exposure could result in sub-lethal impacts, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984). Exposure also can take place via uptake of hydrocarbons through plant membranes and seeds may be affected by contact with oil contained within sediments (NRDA 2012). When seagrass leaves are exposed to petroleum oil, sub-lethal quantities of the soluble fraction can be incorporated into the tissue, causing a reduction in tolerance to other stress factors (Zieman et al. 1984). The toxic components of petroleum oils are thought to be the PAH, which are lipophilic and therefore able to pass through lipid membranes and tend to accumulate in the thylakoid membranes of chloroplasts (Ren et al. 1994). Susceptibility of seagrasses to hydrocarbon spills will depend largely on distribution, with deeper communities protected from oiling under all but the most extreme weather conditions. Shallow seagrasses are more likely to be affected by dispersed oil droplets. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted low concentrations of hydrocarbons predicted in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. Consequently, the potential consequence to seagrass are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to habitat of recognised conservation value.
Marine fauna	Plankton	Injury / mortality to fauna	Plankton are likely to be exposed to in-water hydrocarbons within the upper 0 – 10 m of the water column. Effects will be greatest in the area	Relatively low concentrations of hydrocarbon are toxic to both plankton including zooplankton and ichthyoplankton (fish eggs and larvae). Plankton risk exposure through ingestion, inhalation, and dermal contact. Impacts would

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			close to the spill source where hydrocarbon concentrations are likely to be highest.	predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Once background water quality conditions have re-established, the plankton community may take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, given the limited area exposed by moderate levels of dissolved hydrocarbons, the potential consequence to plankton are considered to be Minor, as they could be expected to result in localised low-level short-term and recoverable impacts.
	Marine invertebrates	Injury / mortality to fauna	In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not predicted as in-water exposure (dissolved or entrained) is only predicted to occur in the upper 0 – 10 m of the water column. Species located in shallow	Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g. crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Invertebrates with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year. Tainting of recreation or commercial species is considered unlikely to occur given exposure is limited to entrained

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			nearshore or intertidal waters may be exposed to in-water hydrocarbons low thresholds. Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to moderate levels of entrained in-water hydrocarbons.	hydrocarbons, however if it did it is expected to be localised and low level with recovery expected. Consequently, the potential consequence to invertebrates, including commercially fished invertebrates are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of value.
	Fish	Injury / mortality to fauna	In-water exposure (dissolved or entrained) is only predicted to occur in the upper 0 – 10 m of the water column the surface layers of the water column. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, as such, exposure to these species is not expected to occur. Any fish or shark species within the surface layers of the water column, may come into contact with the area of predicted exposure for in-water hydrocarbons. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the planning area, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2010). Subsurface hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. Consequently, the potential consequence to fish, including those commercially fished, are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts to species of value. Impacts on eggs and larvae entrained in the upper water column are not expected to be significant given the temporary period of water quality impairment, and the limited geographical extent of the spill. As egg/larvae dispersal is extensive in the upper layers of the water column and it is expected that current induced drift will rapidly replace any oil affected populations. Impacts are assessed as temporary and localised, and therefore considered to be Moderate.
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	Australian and New Zealand fur-seals may occur within the area of exposure. There are no identified BIAs for seals or sea lions within the area of exposure. No known breeding colonies of Australian or New Zealand fur-seals are exposed	Exposure to moderate dissolved or high entrained exposure thresholds in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Due to the temporary and localised nature of the spill, pinnipeds widespread nature, the low-level

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			to moderate dissolved or high entrained exposure thresholds. Given the mobility of pinnipeds, there may be small numbers of seals in the areas predicted to be temporarily exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 -10 m of the water column.	exposure zones and rapid loss of the volatile components of diesel in choppy and windy seas (such as that of the area exposed), the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Cetaceans (whales and dolphins)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the area predicted to be exposed to in-water hydrocarbons. BIAs for foraging for pygmy blue whales and the known core range for southern right whales are within the area predicted to be exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 -10 m of the water column.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the MDO weathers. The potential for impacts to cetaceans and dolphins would be limited to a relatively short period following the release and would need to coincide with seasonal foraging or aggregation event to result in exposure to a large number of individuals, as may be the case during seasonal upwelling events within the Otway region. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and known core range for southern right whales. Consequently, the potential consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Socio-economic	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the planning area and overlap the spatial extent of the water column hydrocarbon predictions.	Any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure are unlikely to manifest at a fish population viability level. Any exclusion zone established would be limited to the safety exclusion zone around the vicinity of the release point, and due to the rapid weathering of hydrocarbons would only be in place whilst well-control activities are enacted, therefore physical displacement to vessels is unlikely to be a significant impact. Consequently, the potential consequence to commercial and recreational fisheries are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts.
	Recreation and tourism	Changes to the functions, interests or activities of other users Change in aesthetic value	Tourism and recreation are linked to the presence of marine fauna (e.g. whales), particular habitats and locations for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds can result in 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	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

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			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.	distance from shore means there may be short-term and localised consequences, which are ranked as Moderate.
	Seaweed Industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted seaweed species. Areas along the west side of King Island where bull kelp is collected may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – north America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. The study did not look at how this would affect the productivity of bull kelp. However, given the low levels of dissolved and entrained hydrocarbons predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title Indigenous Protected Area	Change in aesthetic value Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons is predicted along the Victorian and Tasmanian coastal waters within the planning area which is Sea Country for a number of First Nations groups and is adjacent to the Eastern Maar Native Title claim and Preminghana Indigenous Protected Area.	First Nations people have a connection to Sea Country which could be potentially be impacted by in-water exposure to hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

6.18.8 Control Measures ALARP and Acceptability Assessment – Condensate Spill

Control, ALARP and acceptability assessment: Loss of Containment (condensate)	
ALARP decision context and justification	ALARP Decision Context: Type B Operations of wells, pipeline and subsea infrastructure have been ongoing within the Otway Offshore Development for over a decade with no major incident. Operations are highly regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these LOC events. However, a LOC incident would likely attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
Preventative	
CM#14: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Office (AHO) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue radio-navigation warnings. Relevant details in relation to the operations will be provided to the AHO and AMSA and to relevant stakeholders as required.
CM#15: Permanent Petroleum Safety Zone (PSZ)	PSZs, administrated by NOPSEMA under the OPGGS Act, are specified areas surrounding petroleum wells, structures or equipment which vessels or classes of vessel are prohibited from entering or being present in. Otway Pipeline System and Thylacine-A Wellhead Platform and subsea infrastructure PSZs are clearly marked on navigational charts
CM#2: Marking of Man-Made Offshore Structures	Lighting on the Thylacine-A Wellhead Platform meets Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).
CM#36: NOPSEMA accepted WOMP	Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 set out the requirements for WOMPs. All production and suspended wells covered by this EP have a WOMP detailing • Identify the risks to well integrity. • Describe how the risks are controlled. • Describe the management system in place to ensure the controls are effectively and consistently applied. • Describe the design, construction, operations, management and monitoring of the wells showing how risks to well integrity is reduced to ALARP.
CM#31: NOPSEMA accepted Safety Case	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 set out the requirements for safety cases. The Thylacine-A Platform and Otway Pipeline System Safety Cases demonstrate how the risks to the integrity of the platform, pipeline and subsea facilities will be reduced to as low as reasonably practicable (ALARP). The safety cases: • Identify the hazards and risks. • Describe how the hazards and risks are controlled. • Describe the management system in place to ensure the controls are effectively and consistently applied.

	• Describe the operation, monitoring, inspection and maintenance of the platform, pipeline and subsea facilities. • Describe the leak detection, and emergency shutdown and isolations systems to reduce the extent of loss of containment of hydrocarbons in the event of a loss of containment of the platform, pipeline or subsea facilities.
Response	
CM#36: NOPSEMA accepted WOMP	Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 set out the requirements for WOMPs. All production and suspended wells covered by this EP have a WOMP detailing • Identify the risks to well integrity. • Describe how the risks are controlled. • Describe the management system in place to ensure the controls are effectively and consistently applied. • Describe the design, construction, operations, management and monitoring of the wells showing how risks to well integrity is reduced to ALARP.
CM#37: Source Control Contingency Plan (SCCP) and Relief Well Plan (RWP)	Emergency response capability to implement timely source control in the case of a loss of well integrity is maintained in accordance with well-specific SCCP. Beach SCCPs are consistent with International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (January 2019). Specifically detailing: • The structure and function of the Beach Source Controls Incident Management Team (IMT). • A timeline for the effective implementation of source control key events / actions. • A well-specific worst-case discharge analysis. • Casing design. • Structural integrity analysis. • Gas plume study. Beach relief well plans are developed in accordance with Beach Energy WECS Standard 21 – Source Control Contingency Plan (INT-1000-DRL-STD-17891671) and the Oil & Gas UK Guidelines on Relief Well Planning for Offshore Wells (the OGUK guidelines). Relief well plan ensures that Beach has considered the response requirements in order to: • Reduce the time required to initiate relief well drilling operations in the event of a LOC. • Allow the relief well to be completed in the shortest time practicable. • Relief well plans include a detailed schedule with estimated times to: • Source, mobilise and position a MODU. • Drill and intercept the well. • Complete the well kill successfully.
CM#38: NOPSEMA accepted OPEP	Under the OPGGS(E)R, NOPSEMA require that the petroleum activity have an accepted Oil Pollution Emergency Plan (OPEP) in place before the activity commences. In the event of a LOC, the OPEP will be implemented.

	The Offshore Victoria – Otway Basin OPEP was developed to support all Beach activities within the Otway Basin and includes response arrangements for a worst-case LOC scenario from a development well. The OPEP also includes Tactical Response Plans (TRPs) for identified protection priority areas within the region.
CM#39: NOPSEMA accepted OSMP	Under the OPGGS(E)R NOPSEMA require that the Implementation Strategy of the Environment Plan provides for monitoring of an oil pollution emergency. The Beach OSMP details: • Operational monitoring to inform response planning. • Scientific monitoring to inform the extent of impacts from hydrocarbon exposure and potential remediation requirements.

Additional controls assessed

Control	Control type	Cost/benefit analysis	Control implemented?
Preventative			
Do not undertake production activities	Elimination	Production of fields in the Otway Basin is required to maintain gas supply to the Otway Gas Plant.	No
Source control			
MODU on standby	Equipment	Any MODU on standby would require an in-force Safety Case to operate in Australian Commonwealth waters. The key benefit would be a reduction in the overall shoreline loading from weathered, residual fractions of the condensate. The predicted maximum length of shoreline potentially impacted by low thresholds of hydrocarbon is between 18.9-28.9 km, with the average predicted being between 6.5-9.4 km. There is no predicted shoreline exposure at moderate or high thresholds. Having a MODU on standby would potentially halve the time to implement source control, therefore, the overall potential reduction in exposure to shorelines by halve. Halving the potential loading at a low threshold would produce a marginal overall environment benefit given the nature of weathered condensate. Having a MODU on standby would result in significant additional costs (approx. $800k / day) to Beach that that are considered grossly disproportionate to the level of environmental benefit gained given the relatively small level of potential low threshold shoreline oiling.	No
Capping Stack System (CCS)	Equipment	Well CCS is designed to stem the hydrocarbon flow prior to permanent plugging of the well. As detailed in Table 39: Response option feasibility, effectiveness, ALARP identified risks and capability needs analysis, Beach undertook a feasibility review of CCS for the Otway wells. The feasibility analysis combined with a review of the Otway Basin metocean conditions has confirmed that due to the technical complexity of deploying a capping stack in shallow waters with a gas plume environment and harsh metocean conditions, a relief well is the preferred means of primary source control for the development wells.	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 lower explosive limits. Given the installation of a capping stack is not a feasible response option for the production or suspended wells, and a relief well would be offset to the release location, there is no potential benefit with applying subsea dispersants.	No
Consequence rating	Serious (3)		
Likelihood of occurrence	Remote (1) (7.2 x 10^{-5} per producing well based upon producing gas wells operated to North Sea Standard) ref IOGP Risk Assessment Data Directory Blowout Frequencies September 2019: https://www.iogp.org/bookstore/product/risk-assessment-data-directory-blowout-frequencies/		
Residual risk	Low		
Acceptability assessment			
To meet the principles of ESD	The risk of a loss of containment from a well or pipeline was assessed as low and the highest consequence assessed as serious as there is the potential to result in serious or irreversible environmental damage. However, this is assessed as acceptable based on: • There is little uncertainty associated with this aspect as the activities are well known, the cause pathways are well known, and activities are well regulated and managed. • The implementation of controls make it a remote likelihood that a LOC would occur resulting in a low residual risk. • The actual area of exposure for an individual spill event will be relatively small, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes, thus no irreversible environmental damage is predicted. • It is not considered that there is significant scientific uncertainty associated with this risk. Therefore, the precautionary principle has not been applied.		
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy.		
External context	No objections or claims have been raised during stakeholder consultation regarding the potential for a LOC incident.		
Other requirements	• Operations and integrity of wells, pipeline and subsea equipment is managed as per the requirements of the EP, safety cases and WOMPs required under the OPGGS(E)R and Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations and Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011, respectively. • The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure or source of pressure on the conservation values of the South-east Marine Reserves Network. As detailed in Section 6.18.7 Apolla, Beagle, Franklin and Zeehan AMPs may be potentially exposed to hydrocarbons but impacts to AMP values are not predicted at the threshold levels of exposure. • The following Conservation Advices / Recovery Plans identify pollution as a key threat: ◦ Recovery Plan for Marine Turtles in Australia (CoA, 2017b), identified as acute chemical discharge (oil pollution) ◦ Conservation Advice for *Sterna nereis nereis* (Australian fairy tern) (DSEWPaC, 2011b)		

	◦ National Recovery Plan for the Australian Painted Snipe (CoA, 2022) identified as a deterioration of water quality ◦ Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015c) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) ◦ National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022). ◦ Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015d) ◦ Wildlife Conservation Plan for Seabirds (CoA, 2020a) These conservation advices and recovery plan identify the following conservation actions: • Minimise chemical and terrestrial discharge. Controls have been identified and will be implemented to minimise the risk of minimise chemical discharges. • Ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. No habitats for turtles are identified within the LOC planning area. OPEP and OSMP cover management of response to oiled turtles. • Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. OPEP and OSMP cover response strategies for management breeding sites vulnerable to oil spills. • Implement measures to reduce adverse impacts of habitat degradation and/or modification. Controls have been identified and will be implemented to reduce adverse impacts of habitat degradation and/or modification.
Monitoring and reporting	Loss of containment resulting in a condensate spill is required to be reported as per EP. Impacts as a result of a loss of containment resulting in a condensate spill will be monitored and reported in accordance with the OSMP.
Acceptability outcome	**Acceptable**

6.19 Oil Spill Response

This section presents the risk assessment for oil spill response options as required by the OPGGS(E)R and OPGGS Regulations (Vic).

6.19.1 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 39 provides an assessment of the available oil spill response options, their suitability to the potential spill scenarios and their recommended adoption for the potential spill scenarios.

6.19.2 Hazards

The following activities have been identified for responding to a spill event:

- Mobilisation, use and demobilisation of spill response personnel, plant and equipment.

- 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 39.

Table 39: Response option feasibility, effectiveness, ALARP identified risks and capability needs analysis

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
Monitor and Evaluate	Visual – aerial & vessel Satellite Predictive modelling	Gas condensate	Feasible. Effective – Gas condensate expected to spread to a thin layers on the sea surface within 1 km of the release location. Monitoring used to inform both response planning and monitoring requirements. Hydrocarbons likely visible on sea surface for duration of LOC event. Visual and satellite operational monitoring implemented during LOC event. Scientific monitoring implemented to inform extent of impact and remediation requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. All feasible monitoring techniques have been applied and monitoring personnel and equipment are readily available for deployment. No further benefit gained by having additional monitoring capability. OSMP details the vessels and personnel to implement the appropriate scientific studies.	Yes	Actionable on-water hydrocarbon thresholds limited to immediate vicinity of well site. Up to 8 km of coastline subject to moderate oiling. 1 x plane & observer required and/or 1 x vessel & observer and / or 5 x vessels and OSMP study teams Remote oil spill trajectory modelling (OSTM)	As detailed in OPEP: fixed wing contract in place aerial observers available via AMOSC vessel contract in place OSTM contract in place and available via AMOSC environmental monitoring consultants accessible Implement response as per OPEP and under direction of the State Control Agency (if in State waters) Capability in place and sufficient to implement timely response.
	Visual – aerial and vessel	MDO	Effective - MDO rapidly spreads to thin layers on surface waters. Monitoring used to inform both response planning and monitoring requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. Scientific monitoring implemented to inform extent of impact and remediation requirements. Both vessel and aerial monitoring capability in place. Trained aerial observers available via AMOSC Core Group and available for deployment. Vessel and aircraft contracts in place. No further benefit gained by having additional monitoring capability.	Yes		
Source Control	Relief well	Gas condensate	Due to the remote location of the Otway Basin, available MODU are monitored on a monthly basis throughout operations thus ensuring the mobilisation of a MODU remains feasible within the assumed timeframe of approximately 35 days (the largest time component of the relief well kill). The ongoing assessment of MODU availability shall be conducted with reference to: • MODU with a valid Australian Safety Case. • MODU with the ability to conduct relief well kill operations. • MODU ability to operate in shallow water. • proximity to the Otway Basin. • ability to engage in a mutual aid agreement with the Operator. MODU broker reports shall be used to monitor the MODU market on a monthly basis and, if required, assist in sourcing and contracting a suitable MODU: • The MODU broker can be contracted to identify and contract a suitably specified MODU (including Australian Safety Case status) within 14 days. This allows sufficient time to engage with other operators as well as drilling contractors to confirm availability of MODUs with suitable technical specifications to meet the required engineering well design. • To facilitate timely response, Beach is a signatory to the APPEA Memorandum of Understanding: Mutual Assistance for transfer of MODUs between operators in the case of an Emergency. A MODU that is not currently operating, or in transit to the next operating well, will be preferential and result in a reduced period from the 14 days	Yes	MODU – with Australian Safety Case Casing, drill pipe and consumables identified 3 x Support vessels Well control personnel as detailed in SCCP	As detailed in OPEP, SCCP and relief well plan: access to MODU via APPEA MoU contracts with Well Control Specialists relief well mobilisation strategy and schedule Source Control IMT Implement response as per OPEP, SCCP and relief well plan Capability in place and sufficient to implement timely response

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			allowed for engaging and selecting suitable MODUs. The full 14 days will be required where there are no suitable MODUs not currently in operation and the selected MODU will be required to safely suspend well operations on its existing well prior to commencing of mobilisation to Beach's location. • A MODU mobilised from the NW Shelf or Singapore is likely to take 35 days. These periods have been factored into the relief well schedule within the well-specific relief well plans. • Rating of well control equipment: MODUs considered shall have equipment rated to at least 10,000 psi to perform the required well kill. • Pump capacity of MODU: Suitable to execute the dynamic well kill as per modelling. • Water depth: MODU being considered for relief well drilling must be rated for the minimum water depth of 70 m-100 m. Source control planning has identified all reasonable controls to implement relief well in a timely manner. Beach considers the potential environmental benefit gained by having a pre-positioned alternate MODU on location to be grossly disproportionate given the high financial and logistical support cost associated with having a MODU on standby. All reasonable pre-planning has been undertaken to facilitate the timely initiation of a relief well if required.			
	Capping stack system (CSS)	Gas condensate	To assess the feasibility of CSS deployment Beach engaged Trendsetter Engineering, as the OEM manufacturer of capping stacks, to review various capping stack options for the Otway Basin. The challenge with the Otway Basin is the shallow water (71 m – 101 m) were the production and suspended wells are located and the prevailing metocean conditions of the Otway Basin. The feasibility analyses are detailed in the following two studies: • Beach Energy Capping Stack Shallow Water Feasibility Assessment • GER-9002748_BE CS Non-Vertical Study The assessment focused on gaining a thorough understanding of the issues faced with shallow water deployment of a CSS in a shallow water, gas blowout well environment (such as a development well within the Otway Basin). Trendsetter reviewed available concepts promoted within industry and selected the two most viable deployment concepts for further evaluation with the various CSS. Two alternative offset installation (non-vertical access) methods were applied to four different CSS identified by Beach for potential use on a typical shallow water subsea blowout gas well. The two offset installation methods were: 1. Delmar offset installation method 2. Trendsetter offset installation method The methods are further summarised below. The feasibility analysis combined with a review of the Otway Basin metocean conditions has confirmed that due to the technical complexity of deploying a capping stack in shallow waters with a gas plume environment and harsh metocean conditions, a relief well is the preferred means of primary source control for the development and suspended wells. **Delmar Offset Installation Method** After the review of Delmar offset installation report of the capping stack, one major observation or assumption identified from Delmar's primary installation method was the requirement that the subsea blowout wellhead was left clear, with BOP stack removed previously or not installed at all, so that Delmar's subsea wellhead winches could be established for drawdown operations. For the Delmar method the subsea winch is the primary installation method, with the mudmat winch the secondary drawdown method. The positioning of the capping stack is solely dependent on the use of the drawdown winches.	N/A	N/A	N/A

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment

The subsea hook up would need to be made with vessel support from outside the plume diameter, with adequate safety margin, estimated to be at least 335 m.

Furthermore, with the Delmar method the vertical control is fully dependent on the positive buoyancy of the system, and successful deployment relies heavily on the precisely calculated buoyancy force of the chained buoys, with only minimum control or adjustable measures to compensate the required vertical lifting of the payloads. If the gas plume impact forecast to the buoys is not within the assumed design, then the buoyancy performance will be outside the calculated parameter range.

The main disadvantages that impact the successful installation of the CSS using the Delmar method are thus summarised as:

- dependent on success of BOP stack removal and installation of subsea winches. With a less heavy 7" 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8" 15,000 psi capping stack (OSRL and WWCI).
- increased time for subsea installation of winches, mudmat installations.
- gas plume impact on buoyancy modules needs to be well estimated given vertical control for deployment is dependent purely on the positive buoyancy of the system.
- complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable.

Trendsetter Offset Installation Method

The Trendsetter method relies on a series of chained oceangoing barges to assist in lifting and deployment of the CSS and BOP adaptor spool. The barges are used to assist positioning and ensure the anchor handling vessel is maintained in a safe zone away from the gas plume. In addition, two subsea winches, may be deployed on clump weights on the seabed approximately 30 m from the wellhead and used for lowering and guidance of the capping stack over the damaged well. In general, the subsea drawdown system would be recommended with a less heavy 7" 15,000 psi capping stack (Boots and Coots) and also to assist with successful guidance of the CSS assembly.

Unlike the Delmar method that uses buoyancy modules, these are not required for the Trendsetter method. Furthermore, the use of the drawdown capability is dependent on the wet weight of the stack and the up-thrust forces from the blowout well.

The Trendsetter method does require additional vessels available, and also the successful deployment would be limited in the Otway Basin due to the weather and metocean conditions.

The main disadvantages that impact the successful installation of the CSS using the Trendsetter method are thus summarised as:

- Gas plume impact on oceangoing barges in exclusion zone above blowout well can impact success of the deployment.
- Increased tie for subsea installation of winches, likely recommended to ensure successful guidance of the CSS assembly. With a less heavy 7" 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8" 15,000 psi capping stack (OSRL and WWCI).
- Complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable.

Summary

Rough sea states (as per prevailing in the Otway Basin), including high waves and longer wave periods, can affect the safe operating limits of CSS deployment. The sea state can negatively impact the ability to safety deploy capping stack using a deck crane or A-frame located on the stern of the deployment vessel. Furthermore, if the vessel is experiencing too

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			much heave due to wave action, the CSS could unintentionally hit the subsea wellhead during deployment causing damage to the equipment itself and to the wellhead. High winds can affect both relief well drilling operations and support vessel operations. Support vessels have wind ratings for routine and critical operations, above which, operations may be suspended, and high wind speeds will tend to increase wave heights in open water conditions which can further limit operations. Thus, defined operating limits of acceptable sea states are required for successful deployment of the equipment in adverse sea state environments such as the Otway Basin. The feasibility analysis confirmed a sea state limit of 2 m significant wave height (Hs) and 15 knots (27.8 km/h) winds for defining these limits. The Otway Basin is a predominant moderate to high wave energy environment with wave heights in the summer months average between 2.5 and 3.0 m (8.20 and 9.84 ft), and maximum heights range between 5.6 and 7.7 m (18.4 and 23.0 ft). Wave conditions are more severe in winter, when mean heights range from 3.1 to 3.7 m (10.2 to 12.1 ft) and maximum heights are between 7.6 and 10.3 m (25.0 to 33.8 ft), but all seasons show a relatively high level of wave activity. Winds in the eastern Otway and western Bass Strait area also are generally strong, exceeding 13 knots (more than 23.4 km/h) for 50% of the time. The conditions are thus not operationally suitable for deployment of the CSS. Furthermore, the gas plume environment in shallow water conditions is manifestly different to a deeper water environment due to the exclusion zone above the wellhead preventing vertical installation of the equipment. The feasibility analysis has confirmed that due to the technical complexity of deploying a CSS in shallow waters with a gas plume environment and harsh metocean conditions the use of a capping stack is not operationally suitable for Beach wells within the Otway Basin. Additionally, given the use of a CSS is not operationally suitable for the development wells, the debris clearance tooling as part of the SFRT is not required.			
	Right stricken vessel Transfer MDO to secure tank	MDO	Effective – primary response strategy for all spills in accordance with vessel SMPEP/SOPEP. For MDO source control in Commonwealth waters, AMSA is the Control Agency and has access to NatPlan resources, therefore no further controls are considered. For MDO source control in Victorian state waters, Department of Transport and Planning (DTP) is the Control Agency. Upon establishment of incident control by DTP, Beach shall continue to provide planning and resources as required by the EMT Leader. Beach will make available to DTP an Emergency Management Liaison Officer (EMLO) who can mobilise to the incident control centre. In the event of a cross-jurisdictional response (i.e. where a response is required in State and Commonwealth waters), Beach and DTP will establish a Joint Strategic Coordination Committee (as per the DTP guidance) to facilitate effective co-ordination between DTP and AMSA.	Yes	Contract vessels	Vessel contract in place Capability available at request of AMSA as Control Agency
	Shut-down of production pipeline	Gas condensate	Effective – primary response strategy for all spills resulting from loss of containment from the Otway Pipeline System System pressures are monitored via the distributed control system (DCS) onshore, and the platform and pipeline can be shut down via the DCS or emergency shut down (ESD) can be implemented from the Central Control Room at the Otway Gas Plant.	Yes	None required – remote ESD	None required
Offshore Containment and Recovery	Booms and skimmers	Gas condensate	Not feasible. Actionable surface thickness of 10 g/m^2 is expected in the vicinity of the release location (<1 km) for both seasons and within a response exclusion zone in the event of a LOC scenario.	N/A	N/A	N/A
		MDO	Not feasible. MDO spreads rapidly to less than 10 g/m^2 and suitable thicknesses for recovery are only present for the first 36 hours for a large offshore spill, and there is insufficient mobilisation time to capture residues.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			In general, this method only recovers approximately 10-15% of total spill residue, creates significant levels of waste, requires significant manpower and suitable weather conditions (calm) to be deployed.			
Protection and Deflection	Booms and skimmer	Gas condensate	Potentially feasible. Not effective. No actionable shoreline oil (>100 g/m^2) is predicted to occur on shorelines. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational NEBA	Response personnel Booms & skimmers Waste facilities	As detailed in OPEP: • Core responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. • Environmental monitoring providers accessible • Waste contracts in place • Tactical Response Plans developed for: • Aire River • Princetown • Port Campbell Bay • Curdies Inlet • Implement response as per OPEP and under direction of the State Control Agency • Capability in place and sufficient to implement timely response
		MDO	Potentially feasible. No actionable shoreline oil (>100 g/m^2) is predicted to occur on shorelines. MDO spreads rapidly to less than 10 µm and suitable thicknesses for recovery are only present for the first ~ 36 hours for a worst-case spill. If operational monitoring indicates river mouths and inlets are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing oil within these inland water ways.	Subject to operational NEBA	Response personnel Booms & skimmers Waste facilities	
Shoreline Clean-up	The active removal and/or treatment of oiled sand and debris	Gas condensate	Feasible. Unlikely to be effective in coastal environments of Cape Otway West. The maximum length of actionable shoreline oil is approximately 8 km with initial shoreline contact predicted to occur within 3 days of the release with a maximum loading of 33 m^3 predicted. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. The nature of condensate means that it is difficult to collect from shorelines and can easily be mobilised into lower layers of sand or saltmarsh as may be case in Cape Otway West. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational Net Environmental Benefit Analysis (NEBA) – unlikely to present net benefit	Based up a clean-up rate of 1 m^3 per day per person, a single clean-up team (10 persons) could clean 10 m^3 / day. Based on a waste generation (bulking) factor of 10:1, waste clean-up and recovery could take up to 1 month for a team of 10 people. This assumes that all 33 m^3 of stranded hydrocarbon is both accessible and retrievable. In reality, the total retrievable volume (if any) would be smaller.	As detailed in OPEP: • Core Group responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. • Waste contracts in place • Tactical Response Plans developed for: • Aire River • Princetown • Port Campbell Bay • Curdies Inlet • Implement response as per OPEP and under direction of the State Control Agency • Capability in place and sufficient to implement timely response
		MDO	Feasible. May be effective at reducing shoreline loading where access to the shoreline is possible. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings.			
Oiled Wildlife Response (OWR)	Capture, cleaning and rehabilitation of oiled wildlife.	Gas condensate	Feasible. Effective. At the conservative environmental impact threshold (10 g/m^2) the predicted exposure is limited to the vicinity of the release location (up to 15.3 km for diesel and 0.4 km for condensate). No exposure is predicted at the high threshold (>50 g/m^2) for condensate and up to 2.7 km for diesel. Unlikely to require shoreline oiled wildlife response given no predicted shoreline loading.	Yes	Personnel Equipment Triage and waste facilities	As detailed in OPEP: • Core Group responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. • DEECA are the State agency responsible for responding to wildlife affected by a marine pollution emergency in Victorian waters. DEECA's response to oiled wildlife is undertaken in accordance with the Victorian Wildlife Response Plan for Marine Pollution Emergencies.
		MDO	Feasible. Effective. Unlikely to require shoreline oiled wildlife response given no predicted shoreline loading. Potential that individual birds could become oiled in the offshore environment.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
						• The Tasmanian Oiled Wildlife Response Plan (WildPlan) is administered by the Resource Management and Conservation Division of the DNRET. • If an incident occurs in Commonwealth waters which affects wildlife, AMSA may request support from DEECA or DNRET to assess and lead a response if required. Both DEECA & DNRET have a number of first strike kits as well as access to AMOSC oiled wildlife equipment. • Capability in place and sufficient to implement timely response
Chemical Dispersant Application	Application of chemical dispersants either surface or subsea	Gas condensate	Feasible. Not recommended for Group I oils such as condensate due to the very low viscosity and high volatility – generally no environmental benefit gained by the application of dispersant on Group I oils. Subsea dispersant injection (SSDI) may reduce volatile organic compounds (VOCs) at sea surface within the response area, therefore creating a safer work environment for responders. Given the use of a CSS is not operationally suitable for the production wells, the application of chemical dispersants to reduce surface VOCs is not required.	No	N/A	N/A
		MDO	Feasible. Although "conditional" for Group II oil, the size of potential spill volume and the natural tendency of spreading into very thin films is evidence that dispersant application will be an ineffective response. The dispersant droplets will penetrate through the thin oil layer and cause 'herding' of the oil which creates areas of clear water and should not be mistaken for successful dispersion (see ITOPF – Technical Information Paper No. 4: The Use of Chemical Dispersants to Treat Oil Spills). Dispersant use will have a net negative effect on the environment. Dispersants push the MDO into the water column, creating longer lasting impacts in the water column than allowing the MDO to weather naturally from the sea surface.	No	N/A	N/A

6.19.3 Relief Well Drilling

In the event of a loss of well containment, the Otway and Bass Relief Well Plan (RWP) (T-5100-35-MP-005) will be implemented. This involves mobilising a MODU to site and drilling a deviated well to kill the well in question. This process is described in the RWP.

A relief well is typically drilled as a straight hole down to a planned kick-off point, where it is turned toward the target well using directional drilling technology and tools to get within 30-60 m of the original well. The aim is to align the two wellbores at an incident angle of 3-5° for the eventual intersect rather than aiming directly at the blowout wellbore. The drilling assembly is then pulled and a magnetic proximity ranging tool is run on wireline to determine relative distance and bearing from the target well. Directional drilling continues to about half the distance to the planned intersection, and another magnetic ranging run is made to update relative distance and bearing. Once the target well is penetrated, dynamic kill commences by pumping mud and/or cement downhole to seal the original well bore.

6.19.3.1 Capability Assessment

Beach has put in place the following capabilities to implement a relief well drilling activity:

- The use of qualified and experienced offshore drilling engineers and drilling superintendents to implement source control including a relief well. The Beach Wells Team has competent well engineers that would project manage the relief well in conjunction with Wild Well Control and be guided by the Beach Well Engineering & Construction Management System Standard (WECS) workflow and technical standards.
- Access to a MODU through either:
    - The APPEA MoU.
    - A MODU broker (with monthly reports provided).
- Contracts with world-renowned well control contractors (Wild Well Control and Cudd Well Control) for the provision of specialist personnel and equipment.
- An EMT and Source Controls IMT (and associated plans) that is trained and undertakes regular drills and exercises to maintain a state of preparedness.
- A RWP that outlines a kill well design, MODU mobilisation times and technical considerations that has been prepared in line with international standards.

6.19.3.2 Known and potential environmental impacts

Known and potential environmental risks from mobilising and drilling of a relief well include:

- Localised and temporary impacts to marine users and fishing due to physical presence of the MODU (similar to those described and assessed in Section 6.6).
- Localised and temporary disturbance to marine fauna due to increased light, atmospheric and noise emissions (similar to those described and assessed in Sections 6.2, 6.3, 6.5).

- Localised and temporary impacts to water quality due to increased nutrient and turbidity levels from discharge of putrescible wastes, sewage and grey water, cooling and brine water and bilge water/deck drainage (similar to those described and assessed in Sections 6.8);
- Localised and temporary impacts to water quality and the benthic environment due to the discharge of drill muds, cuttings and cement.
- Localised and temporary disturbance to the benthic environment due to MODU anchoring.
- Impacts associated with the introduction of IMS (Section 6.10).

6.19.3.3Consequence Evaluation

Physical presence

The physical placement of a MODU will result in physical disturbance of the sea floor. This impact would result in localised physical disturbance to benthic habitats. Surveys of previous seabed disturbances from drilling activities of the Victorian coast Basin indicate that recovery of benthic fauna in soft sediment substrates occurs within 6 to 12 months of cessation of drilling (Currie, 2004).

A safety exclusion zone would be required around the MODU, which has potential to impact fisheries and shipping activities. Such impacts are not likely to be any greater than those discussed for the Thylacine-A Wellhead Platform which are assessed as Minor (1). No significant additional impacts on fishing or maritime activities are expected to result from relief well drilling activities.

Routine emissions - light, air and noise

Lights are required for safe operation and navigational safety of a MODU, with visibility considered one of the key controls in place to prevent collisions with third-party vessels. The impacts of lighting will be similar to those from the platform and vessels, which are addressed in Section 6.2 and determined to have a Minor (1) impact.

Air emissions associated with drilling relate to the combustion of MDO on the MODU and in support vessels. As with the impacts assessed in Section 6.3, these are considered to have a Minor (1) environmental impact.

The noise emitted from a MODU consists of a combination of down-hole drill pipe operations including conductor driving and onboard machinery. This typically produces a low intensity but continuous sound for the duration of the drilling activity. The primary concern arising from noise generation from drilling is the potential effect on marine fauna. Impacts on marine fauna from noise from vessels and operations is addressed in Section 6.5 of this EP. The noise generated from a MODU is unlikely to result in significant physiological or behavioural impacts when considered individually or cumulatively with existing noise sources. It is expected that any impacts on marine fauna will be limited to behavioural changes of individuals close to the location and will not result in effects at a species population or ecosystem level. The impacts of sound from the MODU are similar to those of vessels and as outlined in Section 6.5, these impacts are considered Minor (1).

Routine discharges – putrescible waste, sewage and grey water, cooling and brine water, bilge water/deck drainage

Routine discharges from a MODU are very similar to those as described for vessels and assessed in Section 6.8.of this EP.

The key difference is that a MODU contains more POB (typically about 100 people), so there is an increased volume of putrescible and sewage and grey water discharges (though for a short time only). As with the routine discharges of waste from vessels, the impacts of such discharges from a MODU are considered Minor (1).

Introduction of IMS

The introduction of IMS from vessels is addressed in Section 6.10 of this EP. The same issues apply to the operation of a MODU and support vessels due to ballast water discharges and hull fouling. The MODU and support vessels will be required to have relevant biosecurity certifications and be in possession of a ballast water discharge log. This risk is likely to be low to medium.

Discharge of drilling muds and cuttings

Drilling fluids are used to transport drilling cuttings to the surface, prevent well control issues, preserve wellbore stability, and cool and lubricate the drill bit and drill string during drilling. Drill cuttings are rock, gravel and sand removed from the well during the drilling process. The characteristics of the cuttings to be discharged can be predicted from the lithology of other wells drilled in the region and are anticipated to be dominated by calcarenite, shale and sandstone. The cuttings are expected to range in size from fine to course, with a mean size no larger than one centimetre.

The most appropriate drilling fluid for the conditions will be used for relief well drilling. It is likely that water-based muds (WBM) would be used, and the assessment of impacts provided below assumes this. Use of synthetic based muds (SBM), although unlikely, cannot be entirely discounted as it is not possible to define specific drilling requirements for all scenarios where relief well drilling may be required. All drilling products selected will have the lowest environmental risk ranking practicable based on CHARM and OCNS. It is likely that bulk discharge of muds would occur at the conclusion of a relief well drilling campaign, as per normal offshore drilling practice.

The known impacts arising from the discharge of WBM drilling fluids and cuttings are:

- Increased turbidity in the water column.
- Burial of benthic organisms.
- Alteration of the benthic substrate.

There is a substantial amount of literature demonstrating that impacts from the discharged cuttings and muds are generally very localised (100 to 250m from the well), short-lived (less than 24 months), and concentrations of metals or hydrocarbons are generally not detectable beyond 1,000 m (Hinwood et al., 1994).

Potential impacts to water quality and benthic organisms are discussed in the following sections. Note that the volume of muds used will be minimised by use of solids control equipment to ensure maximum retention of fluids within the active mud system.

Water quality and turbidity

Disposal of cuttings with adhered fluid and bulk mud discharges during drilling operations will create plumes of increased turbidity below the point of discharge. Within this plume the larger particles (90-95%) quickly settle on the seabed, usually within a radius of 100-200 m from the MODU. Such particle behaviour has been demonstrated by Terrens et al (1998) at the Fortescue platform in eastern Bass Strait drilling locations.

The dilution of cuttings and drilling fluid plumes is rapid. Data compiled by the US Environmental Protection Agency (US EPA) from numerous studies on the growth and dilution of drilling mud discharge plumes found that the mud had been diluted by approximately one million times by the time it reached a distance of 1 km from the discharge point (USEPA 1985). Nonetheless, drilling cuttings and muds in suspension have the potential to impact components of the marine ecosystem entrained in a discharge plume. Such exposure will in most cases be short term, episodic or pulse-wise depending on plume behaviour.

Some studies have demonstrated minor adverse impacts from turbidity induced by WBM discharges on hard bottom fauna abundance (Hyland et al., 1994), scallops (Cranford et al., 1999) and the blue mussel (Bechmann et al., 2006). These studies indicate that the effect mechanism of cuttings and drilling fluid plumes is mainly physical stress, although chemical toxicity cannot unequivocally be ruled out. The levels of suspended WBM and cuttings causing effects have been above 0.5 mg/L. Such levels are typically restricted to a radius of less than 1-2 km in the water masses (Neff, 1987).

During drilling of a relief there will be an increase in turbidity the immediate area of drilling activity as a result of discharges of cuttings and muds. However, this will be a temporary effect. Tidal currents are substantial, and the interaction of surface and oceanic currents facilitates the dispersion and dilution of cuttings and muds discharged from the MODU, aiding in minimising water column turbidity.

Any reductions in primary productivity (i.e., plankton growth) in the water column as a result of discharges of cuttings and muds will be very localised in the context of the surrounding marine environment. The water depth at the Thylacine and Geographe fields is beyond the photic zone (depth of ocean that receives sufficient sunlight for photosynthesis to occur). Any shading effect of the discharge plume, therefore, will be very low.

In summary, environmental impacts of a turbid plume of cuttings and muds in the highly localised area around the MODU are expected to be Minor (1).

Burial of benthic organisms

Most offshore field studies have shown a minor impact of WBM discharges on benthic fauna except immediately adjacent to platforms where cuttings piles form and persist. Some changes in the local infaunal community structure will occur due to burial and the altered sediment character. The increased bottom micro relief afforded by the accumulation of cuttings may also attract fish and other motile animals and alter the character of epibenthic infaunal communities. Bakke et al (1986) found that fauna recolonisation on sediments capped with 10 mm of WBM cuttings differed little in overall

diversity from that on natural sediment after 1 year, but the species composition was clearly different, which was thought to be due to the WBM cuttings being classified as 'very fine sand' as opposed to the natural sediment being 'medium sand'.

Monitoring in the North Sea has not revealed any in situ effects of WBM cuttings on sediment macrofauna community structure, implying that any such effects, if present, will be confined to the innermost stations in these studies (i.e., nearer than 25-250 m from the discharge point) (various studies cited in Bakke et al., 2013).

Environmental studies undertaken at the Fortescue platform in 70 m depth in western Bass Strait showed that effects to benthic communities from discharge of cuttings and water-based fluids were generally localised and short-lived, with most benthic organisms recovering within four months (Currie et al., 2004). This study showed no detectable trace element indicators when water-based fluids alone were used.

For Apache's East Spar Development in Commonwealth Waters, the area of impact from WBM discharges was not more than 100 m from the drill site and short lived with recovery in less than 18 months (SKM, 1996; Kinhill, 1998). Other studies of the effects of WBM cuttings on sediment fauna also suggest that the impact is normally restricted to within 100-250 m and recovery is rapid (various studies cited in Bakke et al., 2013). There is therefore strong evidence to conclude that sedimentation of WBM cuttings onto the seafloor has only local and short-term effects on the sediment fauna.

In summary, impacts to benthic organisms from the discharge of muds and cuttings from drilling of a relief well are expected to be highly localised and short-term. As the seabed sediments in the Otway Basin are generally uniform and widespread, any consequences at the ecosystem level due to impacts in the highly localised area of the drilling location are expected to be Minor (1).

Discharge of cement

Cementing of a relief well is required to provide effective isolation of the well, and to abandon the well afterwards. Most cement is pumped downhole, however, a small amount of overfill and cement-contaminated mud is likely to occur during the grouting of the uppermost surface casings. No technology currently exists to prevent cement from the uppermost casing wellbores being fully cemented to surface without cement releasing onto the sea floor.

Cement discharges may result in localised, temporary increases in pH at the discharge site. Discharges on the seabed may result in smothering of benthic organisms and areas where cement is overlying sediments will not be suitable for recolonisation by benthic species. Chemicals in the cement mix may result in localised reductions in water quality at the time of the discharge.

The cement chemicals selected for any relief well drilling will be selected in accordance with the chemical selection process described in this EP in order to minimise the impact on the environment of the cement prior to setting as an inert aggregate.

6.19.4 Other Oil Spill Response activities

6.19.4.1 Known and potential environmental impacts

Impacts and risks associated with monitoring and evaluation, source control and protection and deflection response strategies (in responding to a hydrocarbon spill) are similar to those discussed for

vessel and ROV operations in Section 0. This section covers detailed impact and risk evaluations for source control, oiled wildlife response, shoreline protection and clean-up and the application of chemical dispersants.

Oiled wildlife response

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. AMSA as the Control Agency for a vessel spill in Commonwealth waters will managed any OWR and Beach will only undertake OWR if directed by AMSA. Potential impacts are:

- injury/Mortality of fauna
- change in fauna behaviour

Shoreline protection and clean up

Sensitive/protected shoreline habitats may be degraded, or marine fauna and flora and other users of the land may be disturbed due to movement of human responders and removal of oiled material on shorelines. Potential impacts are:

- change in fauna behaviour
- injury/Mortality of fauna
- change in habitat
- changes to the functions, interests or activities of other users

6.19.4.2Consequence evaluation

This section assesses the impacts and risks specific to OWR and shoreline clean spill response strategies.

Oiled wildlife response

OWR includes pre-emptive techniques such as hazing, capturing and relocating of un-oiled fauna as well as post-oiling techniques such cleaning and rehabilitation. Deliberate disturbance of wildlife from known areas of ecological significance (e.g. resting, feeding, breeding or nesting areas) to limit contact of individuals with hydrocarbons may result in inhibiting these species from accessing preferred habitats or food sources. This approach may also result in additional disturbance/handling stress to the affected species with little benefit as many species tend to display site fidelity and return to the location from which they have been moved.

The incorrect handling of oiled fauna has also the potential to result in increased stress levels which has may result in increased fauna mortality. Although fauna interactions from oiled wildlife response and shoreline clean-up techniques are expected to be limited to the duration of the response, there is the potential that these effects may result in longer term impacts to local populations where a large proportion of the local population may be exposed to oil and subsequently oiled wildlife response.

Oiled wildlife preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Oiled wildlife surveillance and wildlife impact studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).

Shoreline protection and clean up

Damage or removal of habitat (such as sand from beaches) from shoreline protection and clean-up techniques may expose shorelines to erosion processes or decrease in fauna and flora. Damage to intertidal shoreline habitats and communities may have indirect effects on ecosystem dynamics through impacts on food chains of the macrofauna communities which they support.

Shorelines are not predicted to be exposure to hydrocarbons at thresholds that are conducive to clean-up thus if shoreline clean-up was undertaken it is unlikely to affect significant stretches of coastline, with prolonged effects on local communities or tourism sites.

If shoreline clean-up is undertaken the movement of spill response personnel, vehicles and equipment through coastal areas has the potential to disturb or damage artefacts or sites of cultural heritage significance. Adverse effects are expected to be localised to the area of disturbance. For known recognised sites, relocation of artefacts or implementation of exclusion zones may be considered as part of the operational NEBA.

Shoreline protection and clean-up preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Hydrocarbon on shorelines and shoreline sediment impacts studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).

6.19.5 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 development wells are in close proximity to shore (54 km – 70 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 6 of the spill, therefore there is adequate time to deploy equipment positioned in Geelong. Additionally, spill modelling indicates potential (hypothetical) areas of exposure to hydrocarbons, post-spill operational monitoring would be required to predict actual or likely exposure locations, therefore determining an area to pre-position equipment may be inaccurate pre-spill.	No
Shoreline protection and clean up: Tactical Response Plans	Precautionary approach	Identified areas for priority protection have pre-populated tactical response plans to reduce response planning timeframes in the event of potential shoreline exposure. Refer to OPEP for TRPs. CM#38: NOPSEMA accepted Oil Pollution Emergency Plan (OPEP)	Yes
Chemical Dispersant: Pre-positioning of dispersant and application equipment.	Precautionary approach	No clear benefit identified as stockpiles of dispersant already available in Melbourne and elsewhere in Australia. Application equipment and dispersant can be readily mobilised to site, with no identified restriction on logistics pathways or response timing.	No
Consequence rating	Moderate (2)		
Residual impact category	Low		
Acceptability assessment			

To meet the principles of ESD	The activities were evaluated as having the potential to result in a Moderate (2) consequence thus is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required. While some response strategies may pose additional risk to sensitive receptors, to not implement response activities may potentially result in greater negative impact to the receiving environment and a longer recovery period. Response activities will be undertaken in accordance with controls which reduce and/or prevent additional risks. The mutual interests of responding and protecting sensitive receptors from further impact due to response activities will be managed using a NEBA during response strategy planning in preparedness arrangements, as well as during a response. Proposed response activities are consistent with industry practice. No impact to KEFS, RAMSAR Wetlands, BIAs or state marine protected areas are expected during spill response.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the SCCP including relief well plan, OPEP, Tactical Response Plans and OSMP.
External context	No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (Control Agencies) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Other requirements	Response has been developed in accordance with: • OPGGS Act. • AMSA Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, 2015); and NOPSEMA (2017). • South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013). In regard to oil spill response, activities associated with Otway Offshore Operations will not be conducted in a manner inconsistent with the objectives of the respective zones of the AMPs, and the principles of the IUCN Area Categories applicable to the values of the AMPs.
Monitoring and reporting	Impacts will be monitored in accordance with Section 8.1.2.
Acceptability outcome	**Acceptable**

7 Environmental Performance Objectives, 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. For each EPO and EPS has been developed in conjunction with measurement criteria. The EPOs, EPSs and measurement criteria related to operations are provided inTable 40 and those related to IMR and vessel operations in

Table 41.

Table 40. Environmental performance outcomes, standards, and measurement criteria - Operations

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity. **EPO3:** Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken. **EPO4:** No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity. **EPO5:** Reduce Beach equity GHG emissions from the Otway Offshore Facilities to as low as reasonably practicable **EPO6**: No impact to water quality or sediment quality at a distance > 500 m from planned activities from	CM#2: Marking of Man-Made Offshore Structures	• When platform unmanned lighting is restricted to navigational lighting.	Platform inspection	Operations Manager
	CM#4: Maintenance Management System	• Power generation systems on platform will be operated in accordance with maintenance management system to ensure efficient operation. • Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.	Maintenance Management System (MMS) records	Operations Manager
	CM#5: Venting Procedures	• Venting is conducted as per operational and maintenance isolation procedures. • Emergency blow down system designed to blow down topside only. • Drain vents purge set points set to meet the minimum operational requirements. • Drain vents purge set points checked as part of platform pre-departure checklist.	Operations and maintenance isolation procedures Blow down system design Platform pre-departure checklist	Operations Manager
	CM#7: Emission Abatement Opportunities Register	Per the requirements of the OEMS Sustainability Standard, Beach will maintain a register of opportunities for emissions reduction across its asset portfolio to reduce: • emissions from combustion • electricity consumption • venting and flaring These opportunities will be evaluated according to the criteria in the GHG Management Plan (CM#8), the criteria including relative cost per tonne of CO_2 equivalent abated, comparable carbon credit price and Net Present Value compared to other facilities	Abatement Opportunities Register Asset Reference Plans Yearly budget cycle documents Sustainability Steering Committee meeting minutes	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
planned marine discharges. **EPO7:** Seabed and associated biota disturbance will be within the operational area.		both in Australia and New Zealand, reflecting Beach's portfolio approach to greenhouse gas abatement opportunities. These opportunities that are determined to be practicable for the Otway Offshore Facilities will be included in the yearly budget cycle for review, assessment, and approval where appropriate. Completion of GHG reduction opportunities related to the Otway Offshore Facilities will be independently tracked through to completion via Beach's Sustainability Steering Committee as a standing agenda item.		
	CM#8: Beach GHG Management Plan	Beach Energy will progressively implement its GHG Management Plan from 1 January 2023. Full implementation of the plan is targeted for the Otway Offshore Facilities by 30 June, 2024 and for all Beach facilities by 30 June, 2025. The GHG Management Plan formalises the framework and specific techniques used to ensure that GHG emission related EPOs will be met over the life of the facilities. In particular, the GHG Management Plan will set out the requirements for: • Monitoring of Scope 1, Scope 2 and Scope 3 GHG emissions at each asset. • Methodology used to monitor yearly indirect emissions generated by selected offshore upstream suppliers and downstream contractors and estimates of indirect emissions from the use of the total hydrocarbon products from Beach's Otway asset. • A stewardship program to monitor indirect (Scope 3) GHG emissions by: ◦ Monitoring GHG emission reduction commitments of customers. ◦ Working with Beach customers to explore GHG emission reduction opportunities.	Beach Energy GHG Management Plan developed and implemented. Annual Scope 1, Scope 2 and Scope 3 GHG emissions monitoring reports Customer GHG emission reduction policy and implementation reviews Records demonstrate review of decarbonisation opportunities with customers	Head of Sustainability and Energy Solutions responsibilities

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• Review of the GHG Management Plan requirements by comparison of Scope 1 and 2 emissions against internal forecasts and monitoring Scope 3 emissions for Beach's Otway asset against internal forecasts. • Maintaining of a record of opportunities related to reductions of fuel, flare and venting Scope 1 emissions. • Establishing a LDAR program at the Otway Offshore Facilities documenting the scope, methodology, frequency, and repair guidance. • Assessment criteria to be used to assess merits of emissions reduction opportunities and decision making criteria for adoption.		
	CM#9: Fugitive Leak Detection and Repair Program	Implement an offshore leak detection and repair (LDAR) fugitive emissions surveys aligned with the LDAR program for onshore facilities as per the GHG Management Plan (CM#8) in which the scope, extent, frequency, method, and repair decision-making criteria are detailed to meet the Protocol for Environmental Management (Minimum control requirements for stationary sources) – US EPA Publication 21.	LDAR surveys implemented as per GHG Management Plan requirements LDAR fugitive emissions report	Operations Manager
	CM#10: Emissions Monitoring	GHG emissions will be reported as required by NGERS regulatory requirements. Scope 1 GHG emissions, generated by the Otway Offshore Operation and reported via NGERS, will be compared annually to internal forecasts. Stewardship of Scope 3 emissions derived from Beach's Otway asset's activities includes: • Emissions from combustion of final product will be estimated for the Otway asset and compared against annual forecast. • Customer commitments to emissions reduction and published targets will be monitored.	Annual review of Scope 1 and Scope 2 GHG emissions. Estimates of Scope 3 emissions from product use Monitoring of indirect Scope 3 emissions from aviation and offshore vessels.	Head of Sustainability and Energy Solutions responsibilities

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• Engagement with customers to discuss emission reduction opportunities. • Scope 3 emissions from upstream and downstream service providers will be recorded and monitored.	GHG emissions regulatory requirement reports.	
	CM#26: Bird Deterrent system	• Bird deterrent system has been developed as per the recommendations of the bird management specialists. • Water sprinkler used when birds are present. • Operators of the bird deterrent systems are trained and following standard operating systems. • Operators of the bird deterrent systems are trained and follow standard operating systems. • The water sprinkler is used daily (when birds are present), even when helicopter flights are not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers and hence lowering the risk of being harmed. • Bird laser would initially be used for a limited time at dusk and dawn prior to scheduled helicopter operations. Further trials will be undertaken to determine whether nighttime operations would be effective. • Monitoring of the platform cameras will be used to determine that there are no species of concern on the helideck prior to operation of the laser.	Bird deterrent system report Operator training records Records of laser usage prior to helicopter operations, including platform observations from the cameras	Operations Manager
	CM#22: Hazardous Materials Risk Assessment	• Chemicals that could be discharged to the marine environment will meet the requirements of the Beach Chemical Management Plan	All chemicals used in day-to-day Operations will be listed in the Dangerous Goods Manifest Otway – Offshore / Onshore. Any chemical discharged to the marine environment	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
			have been assessed in section 6.9.4. Any chemicals not included in this Manifest will be assessed as per the EPS prior to use.	
	CM#24: Hydraulic Control System	• Hydraulic system is fitted with low pressure and low level alarms that are monitoring at the Otway Gas Plant. • Hydraulic control system inventory levels are monitored monthly, and any excess use is investigated. • Hydraulic control system inspected and maintained in accordance with the Maintenance Management System.	Hydraulic system alarm records Monthly monitoring report Excess use investigation Maintenance Management System records	Operations Manager
EPO8: Undertake the activity in a manner that will not interfere with other marine users to a greater extent than is necessary for the exercise of right conferred by the titles granted.	CM#14: Ongoing consultation	• Notifications for any on-water activities and ongoing consultations shall be undertaken as per the EP.	Notification records Communication records	Offshore Project Manager
	CM#15: Permanent Petroleum Safety Zone (PSZ)	• A permanent PSZ shall be maintained for the Thylacine-A wellhead platform and Geographe and Thylacine subsea infrastructure. • Otway Pipeline Systems and Thylacine-A wellhead platform and Geographe and Thylacine subsea infrastructure PSZ marked on navigational chart.	PSZ Gazetted Notice Navigational chart	Operations Manager
	CM#16: Beach Fair Ocean Access Procedure	• The Beach Fair Ocean Access Procedure (Appendix D for overview) shall be implemented with Fishers who have identified they fish in the area and have a commercial loss due to Beach's activities.	Communication records	Community Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#17: Navigation and communication aids	• Platform is provided with navigational lights, RACON and foghorn in accordance with International Association of Lighthouse Authorities (IALA) requirements: • Foghorn is provided with its own battery back-up which will supply power for 96 hours. • Navigational lights on the Thylacine-A wellhead platform are in accordance with Navigation Act 2012 (Cth) (Chapter 6, Part 3, Division 2 – Collisions, Lights and Signals).	Platform inspection CMMS	Operations Manager
EPO10: No unplanned discharge of waste to the marine environment.	CM#27: MO 95: Marine Pollution Prevention – Garbage	• Waste with potential to be windblown shall be stored in covered containers.	HSE inspection records Garbage record book Incident report	Operations Manager
	CM#28: Fabric Maintenance	• Grit blasting on the platform jacket and topsides uses containment and recovery to minimise losses to the ocean. • Grit blasting material will meet the chemical acceptance criteria as per Section 8.21.	Maintenance activity reports	Operations Manager
EPO11: No spills of chemicals or hydrocarbons to the marine environment.	CM#31: NOPSEMA accepted Safety Case	• Pipelines and subsea infrastructure and integrity managed in accordance with the accepted Safety Case.	Accepted Safety Case in place Inspection records	Operations Manager
	CM#29: Spill containment	• Suitable bunding will be installed to prevent unplanned spills of chemicals entering the environment. • Spill kits are present on the platform.	Platform / vessel inspection	Operations Manager
	CM#32: Thylacine-A Wellhead Platform Hose Integrity Management Plan	• Hoses are managed and maintained as per Thylacine-A Wellhead Platform Hose Integrity Management Plan.	Thylacine-A Wellhead Platform Hose Integrity Management Plan	Operations Manager
	CM#14: Ongoing consultation	• Notifications for any on-water activities and ongoing consultations shall be undertaken as per the EP.	Notification records Communication records	Offshore Project Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#2: Marking of Man-Made Offshore Structures	• Lighting on the Thylacine-A Wellhead Platform meets Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures.	Platform inspection	Operations Manager
	CM#36 NOPSEMA accepted WOMP	• Wells and well integrity managed in accordance with the accepted WOMP.	Accepted WOMP in place Inspection records	Operations Manager
	CM#37: Source Control Contingency Plan (SCCP) and Relief Well Plan (RWP)	• Emergency response capability to implement timely source control in the case of a loss of well integrity is maintained in accordance with well-specific SCCP and RWP.	Capability as per SCCP and RWP in place	Wells Manager Otway Offshore
		• The SCCP shall be consistent with the International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (2019), Specifically detailing: ◦ the structure and function of the Beach Source Controls Incident Management Team. ◦ a timeline for the effective implementation of source control key events / actions. ◦ a well-specific worst-case discharge analysis. ◦ casing design. ◦ structural integrity analysis. ◦ gas plume study. • The relief well plan ensures that Beach has considered the response requirements in order to: ◦ reduce the time required to initiate relief well drilling operations in the event of a LOC. ◦ allow the relief well to be completed in the shortest time practicable.	Capability as per SCCP and RWP in place	Wells Manager Otway Offshore

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• The relief well plan includes a detailed schedule with estimated times to: ◦ source, mobilise and position a MODU. ◦ drill and intercept the well. ◦ complete the well kill successfully.		
	CM#38: NOPSEMA accepted OPEP CM#39: NOPSEMA accepted OSMP	Emergency spill response capability is maintained in accordance with the OPEP	Outcomes of internal audits and tests demonstrate preparedness	Senior Crisis, Emergency & Security Advisor
		Implement spill response in accordance with relevant EPOs and EPSs in the accepted OPEP.	EMT log	Beach EMT
		Operational and scientific monitoring capability is maintained in accordance with the OSMP.	Outcomes of internal audits and tests demonstrate preparedness	Senior Crisis, Emergency & Security Advisor
EPO12: All structures, equipment and property associated within the Beach title areas will be maintained in good condition and repair to ensure it can be removed, unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP.	CM#21: Beach OEMS Element 6 Asset Management	• IMR programs are undertaken to maintain structures, equipment and property in good condition and repair until it is removed, unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP, by • Wells and well integrity managed in accordance with the accepted WOMP. • Thylacine-A Wellhead Platform, pipelines and subsea infrastructure and integrity managed in accordance with the accepted Safety Case.	Accepted Safety Case in place Accepted WOMP in place Inspection records	Operations Manager

Table 41. Environmental performance outcomes, standards and measurement criteria – IMR, Geophysical Surveys and Support Operations

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity. **EPO2:** Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area. **EPO3:** Biologically important behaviours within a BIA or outside a BIA can continue while the	CM#1: Light Management Procedure	• Vessels will have a Lighting Management Procedure (or equivalent) to minimise light spill by: ◦ keeping lights off when not needed. ◦ directing lighting onto work areas. ◦ screening interior lights with curtains and blinds. ◦ developing a program for handling grounded birds. ◦ reporting requirements. • The Vessel Lighting Management Procedure (or equivalent) will meet the requirements detailed in Beach Energy's Vessel Light Management Procedure Guidance (CDN/ID 19012450).	Lighting Management Procedure (or equivalent) Beach Energy's Vessel Light Management Procedure Guidance Vessel inspection	Vessel Master
	CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	• Vessel operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with dolphins specifically: ◦ Do not approach a dolphin. ◦ Maintain a distance of 150 m from a dolphin. ◦ If a dolphin approaches the vessel try to maintain the separation distances without changing direction or moving into the path of the animal. • Vessel operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with whales, specifically: ◦ Do not approach a whale. ◦ Maintain a distance of 500 m from a whale. • If a whale approaches the vessel it will try to maintain the separation distances without changing direction or moving into the path of the animal. • Helicopters will not fly lower than 1650 ft when within 500 m horizontal distance of a cetacean except when landing or taking off and will not approach a cetacean from head on.	Project induction DCCEEW cetacean sighting sheets	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
activity is being undertaken. **EPO4:** No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity.		• Marine mammal sightings will be recorded and submitted to DCCEEW via the National Marine Mammal Data Portal. Sighting will be reported within 1 month of sighting occurring or two months of the end of a geophysical survey.		
	CM#13: Otway Operations Vessel Whale Management Procedure	• Prior to an activity commencing a pre-activity survey will be undertaken of the activity survey zone for the activity: ◦ Resupply – 7.5 km ◦ Inspection – 3 km ◦ Maintenance and repair – 3 km • Surveys will be undertaken for 30 min prior to the activity commencing. If a whale is sighted within the pre-activity survey zone the activity will not commence until: ◦ No whales are observed for 30 min within the pre-activity survey zone; or ◦ Whales are observed leaving the pre-activity survey zone. • Once the activity has commenced observations will be undertaken within the activity survey zone: ◦ Resupply – 7.5 km ◦ Inspection – 3 km ◦ Maintenance and repair – 3 km • If a whale is sighted within the activity survey zone the following will occur: ◦ If the vessel can do so it will move away from the whale and maintain a minimum separation distance equal to the activity survey zone. ◦ If the vessel cannot move away from the whale, the vessel will reduce thrusters if safe to do so. The activity will cease as soon as it is safe, and the vessel will move out of the activity survey zone. • Activities can commence at night or in low visibility conditions (i.e., when observations cannot be undertaken) if no more than three whales have been seen in the activity survey zone in the preceding daylight hours.	Daily report MMO report Review of whale data	Operations Manager Activity Offshore Representative Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#13a: Otway Operations Vessel Marine Mammal Observer	• A dedicated MMO with experience in whale observation, distance estimation and reporting, will undertake activity survey zone observations for vessel activities undertaken over a period greater than 24 hours. • In addition, vessel crew who act as Officer of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO during daylight hours. • For vessel activities greater than 5 consecutive days at sea an additional dedicated MMO trained in whale observation, distance estimation and reporting will be onboard the vessel to support the experienced MMO. • For vessel activities that will be undertaken over a period less than 24 hours the vessel Officer of the Watch will undertake the activity survey zone observations. They will be trained in the Vessel Whale Management Procedure, whale observation and distance estimation.	MMO qualifications Daily report MMO report Officer of the Watch training	Operations Manager Activity Offshore Representative Vessel Master
	CM#13b: SRW Exclusion Zone	No IMR activities will be planned within 3 km of the reproduction BIA during May to end of September when southern right whales are potentially present in the BIA.	IMR schedule	Operations Manager
	CM#12a: Geophysical survey pre-start visual observation	For the geophysical survey: • A prestart visual observation period of 30 mins will be applied to 500 m prior to the start of SBP equipment activation. • If during the prestart visual observation period, a whale is sighted within 500 m of the vessel the SBP equipment activation will be delayed until the whale has moved outside of the 500 m zone or 30 minutes has lapsed since the last whale sighting within 500 m. • SBP equipment will not be started at night if there have been three or more delays to the start-up of the equipment due to whales in the last 24 hours. • Once the survey has comments CM#11 applies where the vessel is required to maintain a 500 m distance to all whales.	Daily report details pre-start Observation period, any sightings and any actions required.	Activity Offshore Representative
	CM#12b: Geophysical survey Marine	For geophysical surveys utilising SBP a dedicated MMO will be present on the vessel to undertake prestart visual observations and implement the 500 m distance to any whales. The MMO will have proven experience in whale observation, distance estimation and reporting.	MMO resume. Daily report detailing MMO observations.	Activity Offshore Representative

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	Mammal Observer			
	CM#12c Geophysical survey adaptive management	For geophysical surveys utilising SBP if whale numbers are greater than expected such that pre-start observations are delayed three times in a 24-hour period or the vessel must move away from a whale or a pod of whales three times in a 24-hour period, a review of the controls in place will be undertaken by the Activity Offshore Representative, Activity Project Manager and Environment Advisor. • The review will be initiated within 2 hours of the adaptive management trigger being reached. • the review will be documented and will be undertaken against the Implementation of the EPBC Act Policy 2.1 Part A requirements to identify if further controls need to be applied to ensure that impacts and risks are ALARP and within the defined acceptable level.	Adaptive management review report	Activity Offshore Representative
	CM#3: MO 97: Marine Pollution Prevention – Air Pollution	• Use of very low sulphur fuel oil (VLSFO) (e.g. maximum 0.50% S VLSFO-DM, maximum 0.50% S VLSFO-RM). • Vessels with diesel engines>130 kW must be certified to emission standards (e.g. International Air Pollution Prevention [IAPP]). • Vessels shall implement their Ship Energy Efficiency Management Plan to monitor and reduce air emissions (as appropriate to vessel class).	Bunker receipts Ship Energy Efficiency Management Plan (SEEMP) records Certification documentation Vessel inspection	Vessel Master
	CM#4: Maintenance Management System	• Power generation and propulsion systems on vessels will be operated in accordance with maintenance management system to ensure efficient operation.	Maintenance Management System (MMS) records Vessel inspection	Vessel Master
	CM#6: Contractor Supplier HSE Prequalification	• The tender evaluation for the IMR and support vessels contract will include an evaluation of air and GHG emissions management.	Contractor Supplier HSE Prequalification and Capability Assessment	IMR Project Manager Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	and Capability Assessment			
EPO6: No impact to water quality or sediment quality at a distance > 500 m from planned activities from planned marine discharges. **EPO7:** Seabed and associated biota disturbance will be within the operational area.	CM#20: IMR Scope of Work	• IMR scope of work will detail activities that may disturb the seabed and how these activities will limit the area of disturbance.	IMR Scope of Work	IMR Project Manager
	CM#23: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	• Oil contaminated water shall be treated via a MARPOL (or equivalent) approved oily water separator and only discharge if oil content less than 15 ppm. • Sewage discharged at sea shall be treated via a MARPOL (or equivalent) approved sewage treatment system. • Food waste only discharged when macerated to ≤25 mm and at distance greater than 3 nm from land.	Oil record book MARPOL certification Garbage record book Vessel inspection	Vessel Master
	CM#4: Maintenance Management System	• Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.	Maintenance Management System (MMS) records Vessel inspection	Vessel Master
	CM#22: Hazardous Materials Risk Assessment	• Chemicals that will be or have the potential to be discharged to the marine environment will meet the chemical acceptance criteria.	All chemicals used in day-to-day Operations will be listed in the Dangerous Goods Manifest Otway – Offshore / Onshore. Any chemical discharged to the marine environment	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
			have been assessed in section 6.9.4. Any chemicals not included in this Manifest will be assessed as per the EPS prior to use.	
EPO8: Undertake the activity in a manner that will not interfere with other marine users to a greater extent than is necessary for the exercise of right conferred by the titles granted.	CM#14: Ongoing consultation	• Notifications for any on-water activities and ongoing consultations shall be undertaken as per the EP.	Notification records Communication records	IMR Project Manager
	CM#16: Beach Fair Ocean Access Procedure	• The Beach Fair Ocean Access Procedure (Appendix D for overview) shall be implemented with Fishers who have identified they fish in the area and have a commercial loss due to Beach's activities.	Communication records	Community Manager
EPO9: No introduction of a known or potential invasive marine species	CM#25: Beach Domestic IMS Biofouling Risk Assessment Process	Prior to the initial mobilisation into the operational area of any vessel or submersible equipment, Beach shall undertake a domestic IMS biofouling risk assessment to: • Validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational area. • Identify the potential IMS risk profile of vessels and submersible equipment prior to deployment within the operational area. • Identify potentially deficiency of IMS controls prior to entering the operational area. • Identify additional controls to manage IMS risk.	Domestic IMS Biofouling Risk Assessment records	IMR Project Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• Prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).		
EPO10: No unplanned discharge of waste to the marine environment.	CM#27: MO 95: Marine Pollution Prevention – Garbage	Waste with potential to be windblown shall be stored in covered containers.	Vessel inspection Garbage record book Incident report	Vessel Master
EPO11: No spills of chemicals or hydrocarbons to the marine environment.	CM#29: Spill containment	Materials and equipment that have the potential to spill onto the deck or marine environment shall be stored within a contained area.	Vessel inspection.	Vessel Master
	CM#30: SMPEP or SOPEP (appropriate to class)	Vessels shall have a SMPEP (or equivalent appropriate to class) which is: implemented in the event of a spill to deck or marine environment. tested as per the vessel test schedule. spill response kits shall be available and routinely checked to ensure adequate stock is maintained.	Vessel SMPEP Vessel inspection Vessel exercise schedule	Vessel Master
	CM#14: Ongoing consultation	Notifications for any on-water activities and ongoing consultations shall be undertaken as per the EP.	Notification records Communication records	IMR Project Manager
	CM#33: MO 21: Safety and emergency arrangements	Vessels shall meet the safety measures and emergency procedures of the AMSA MO 21.	Vessel inspection	Vessel Master
	CM#18: MO 30: Prevention of collisions	Vessels shall meet the navigation equipment, watchkeeping, radar and lighting requirements of AMSA MO 30.	Vessel inspection	Vessel Master
	CM#34: MO 31: SOLAS and	Support vessels will meet survey, maintenance and certification of regulated Australian vessels as per AMSA MO 31.	Vessel certification	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	non-SOLAS certification			
	CM#19: MO 27: Safety of navigation and radio equipment	Vessels shall meet the safety of navigation and radio equipment requirements of AMSA MO 27. Vessels shall ensure their navigation status is set correctly in the ship's AIS unit.	Vessel inspection	Vessel Master
	CM#35: Vessel fuel type	Vessels contracted to conduct activities under this EP will only carry marine diesel.	Vessel inspection	Operations Manager Project Manager

8 Implementation Strategy

This chapter provides a description of how the commitments outlined throughout the summary EP will be implemented, as required under the OPGGS(E)R and OPGGS Regulations (Vic).

The Beach Operations Excellence Management System (OEMS) will be used to govern the activity. The OEMS provides guidance on how Beach will meet the requirements of its Environmental Policy. The Beach OEMS has been developed considering Australian/New Zealand Standard ISO 14001:2016 Environmental Management Systems. The OEMS is an integrated management system and includes all HSE management elements and procedures.

The Implementation Strategy described in this section provides a summary of the OEMS elements and how they will be applied to effectively implement the control measures detailed in this EP. Specifically, it describes:

- The OEMS.
- Environment-specific roles and responsibilities.
- Arrangements for monitoring, review and reporting of environmental performance.
- Preparedness for emergencies.
- Arrangements for ongoing consultation.

At the core of the OEMS are 11 elements and associated standards that detail specific performance requirements that incorporate all the requirements for the implementation of the Environmental Policy, and management of potential HSE impacts and risks (Table 42). The Elements, via the nominated expectations, sponsor 30 Beach OEMS Standards, which provide more granular minimum compliance rule sets under which the company operates. At the business level, the system is complemented by asset and site procedures and plans such as this EP.

There are three standards and 11 outcomes (Figure 25) to be delivered under this element. To this effect, Beach's Environment Policy provides a clear commitment to conduct its operations in an environmentally responsible and sustainable manner.

Table 42: Beach OEM Elements and Standards

Element		Standard
1	Partners, Leadership and Authority	Leadership Standard
		Technical Authority Standard
		Joint Venture Management Standard
2	Financial Management and Business Planning	Integrated Planning Standard
		Phase Gate Standard
		Hydrocarbon Resource Estimation and Reporting Standard
		Financial Management Standard
3	Information Management and Legal Requirements	Regulatory Compliance Standard
		Document Management Standard
		Information Management Standard
4	People, Capability and Health	Training and Competency Standard
		Health Management Standard
5	Contracts and Procurement	Contracts and Procurement Standard
		Transport and Logistics Standard
6	Asset Management	Asset Management Standard
		Maintenance Management Standard
		Well Integrity Management Standard
		Well Construction Management Standard
		Project Management Standard
7	Operational Control	Operational Integrity Standard
		Process Safety Standard
		Management of Change Standard
8	Risk Management and Hazard Control	Risk Management Standard
		Safe Systems of Work
		Emergency and Security Management Standard
9	Incident Management	Incident Management Standard
10	Environment and Community	Environment Management Standard
		Community Engagement Standard
11	Assurance and Reporting	Sustainability Standard
		Assurance Standard

Figure 25: Beach OEMS

8.1 Standard 8.3 – Emergency and Security Management Standard

Standard 8.3 defines the minimum performance requirements to effectively manage credible emergency and security events, and to enable an efficient recovery to normal operations following such an event. The Standard defines the prevention, preparedness, response and recovery principles to be applied, the organisational structures to support emergency and security measures, and the training and testing protocols that must be in place to assure Beach maintains a state of readiness.

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

8.1.1 Emergency Response Framework

The Beach Crisis and Emergency Management Framework consists of a tiered structure whereby the severity of the emergency triggers the activation of emergency management levels. The emergency response framework contains three tiers based on the severity of the potential impact, as outlined in Figure 26. This framework is described in the Beach Emergency Management Plan (EMP) (CDN/ID 128025990).

The responsibilities of the Emergency Response Team (ERT), Emergency Management Team (EMT) and Crisis Management Team (CMT) are outlined in Table 43

The key emergency response arrangements for the activity are outlined herein.

Beach Emergency Management Plan

The Beach EMP provides the standard mechanism for the EMT to operate from and includes guidance on effective decision-making for emergency events, identification, assessment and escalation of events and provides training and exercise requirements. The EMP provides information on reporting relationships for command, control and communications, together with interfaces to emergency services specialist response groups, statutory authorities and other external bodies. The roles and responsibilities are detailed for onshore and offshore personnel involved in an emergency, including

the response teams, onshore support teams, visitors, contractors and employees. The EMP details the emergency escalation protocol depending on the nature of the emergency.

Associated with the EMP are the Emergency Response Duty Roster and Contact Lists. These documents constitute a suite of emergency response documents that form the basis for Beach's response to an emergency situation.

IMR Activity Emergency Response Plan

For IMR activities Beach will prepare a bridging emergency response plan (ERP) that bridges to the emergency response measures in the vessel contractor's vessel-specific ERP to ensure that all emergency management functions are accounted for. The Bridging ERP will be supported by the Beach EMP.

The Bridging ERP will describe the emergency roles and responsibilities for those on the vessel and outline the actions to be taken for potential activity-specific scenarios (e.g., loss of containment, vessel collision, fire, man overboard, fatality, etc). The Bridging ERP will define the communication requirements to notify both the company and external bodies of the incident so as to obtain assistance where needed and to fulfil reporting obligations.

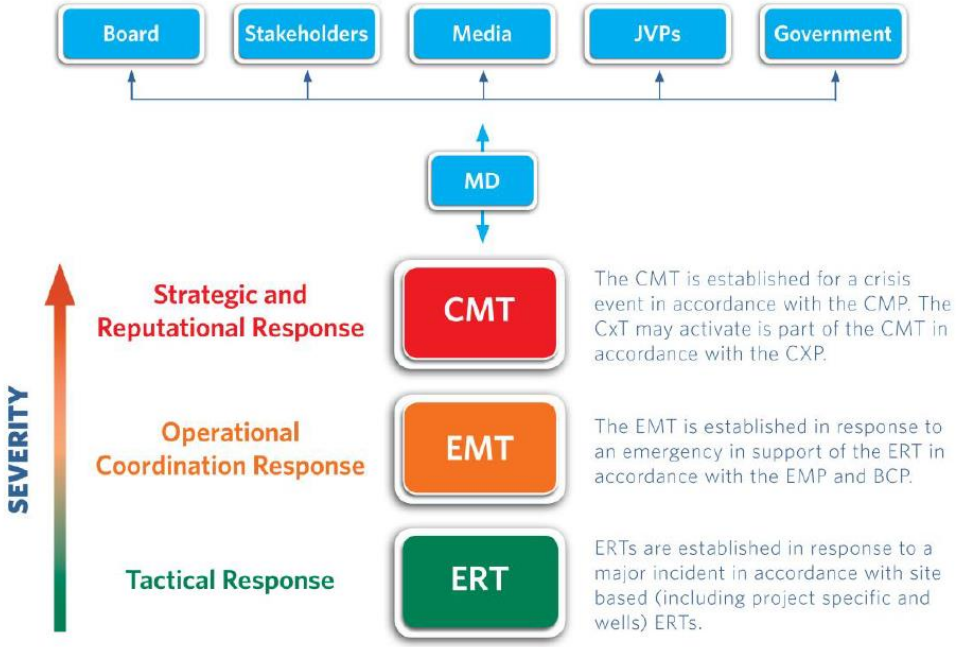

Figure 26: Beach Crisis and Emergency Management Framework

Table 43: Responsibilities of the Beach Crisis and Emergency Management Teams

Team	Base	Responsibilities
CMT	Adelaide head office	Strategic management of Beach's response and recovery efforts in accordance with the Crisis Management Plan. Provide overall direction, strategic decision-making as well as providing corporate protection and support to activated response teams.

Team	Base	Responsibilities
		Activate the Crisis Management Team (CMT) if required.
EMT	Adelaide, Melbourne	Provide operational management support to the Emergency Response team to contain and control the incident. implement the Business Continuity Plan. Liaise with external stakeholders in accordance with the site-specific Emergency Response Plan. Regulatory reporting.
ERT	Site Vessel	Respond to the emergency in accordance with the site-specific ERP.

8.1.2 Oil Pollution Emergency Plan

Oil spill response arrangements associated with Otway Offshore Operations are detailed in the Beach Victorian Offshore Oil Pollution Emergency Plan (OPEP) (CDN/ID 18986979/VIC 1000 SAF PLN).

The COVID-19 pandemic resulted in restrictions or measures being implemented to address the pandemic. These restrictions or measures can potentially impact oil spill response arrangements. For all Beach activities within the Otway Development area, which includes the Otway Offshore Operations, the environmental risk profile has been reviewed with respect to the commitments in EPs and OPEP.

Audits and Assessments and the OPEP Section 10 On-Going Response Preparedness and Exercises detail the processes that Beach will undertake to ensure that oil spill response requirements can be met during operations and for IMR activities.

8.1.3 Operational and Scientific Monitoring Plan

Operational and scientific monitoring arrangement associated with Otway Offshore Operations are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and Otway Offshore Operations OSMP Addendum (CDN/ID 18987652).

The planning area is based on low exposure shoreline, surface and in-water threshold for a diesel or condensate spill. The particular values and sensitivities that may require monitoring in the event of a diesel or condensate spill are detailed in the following Sections:

- Conservation Values and Sensitivities
- Ecological Environment
- Biologically Important Areas
- Socio-economic Environment
- First Nations

8.1.4 Testing of Spill Response Arrangements

The OPEP details the oil spill response testing arrangements.

9 References

ABS. (2021) Australian Bureau of Statistics. https://www.abs.gov.au/

AIATSIS. (2022). Welcome to Country. The Australian Institute of Aboriginal and Torres Strait Islander Studies. https://aiatsis.gov.au/explore/welcome-country

Australian Seaweed Institute (2023). https://www.australianseaweedinstitute.com.au/current-state-of-the-australian-seaweed-industry

Boreen, T., James, N., Silson, C., Heggi, D (1993). Surfical cool-water carbonate sediments on the Otway continental margin, Southeastern Australia. Elsevier Science Publishers BV., Marine geology, 112 (1993) 35-56.

CEE Consultants Pty Ltd (2003). Otway Gas project Gas field and Subsea Pipeline Marine Biological Conditions, Existing Conditions and Impact Assessment.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2023b). National Conservation Values Atlas. Department of Climate Change, Energy, the Environment and Water, Canberra. http://www.environment.gov.au/topics/marine/marine-bioregional-plans/conservation-values-atlas

Department of Defence (DoD) (2022). Categories for Unexploded (UXO) Ordnance Potential – Categorisation Criteria, Warnings and Advice – webpage. A WWW webpage accessed in December 2022 at Categories for UXO Potential: Where is UXO?: Department of Defence. Canberra.

Department of Industry, Science, Energy and Resources (2022) Guideline: Offshore petroleum decommissioning In relation to the Offshore Petroleum and Greenhouse Gas Storage Act 2006.

Department of Primary Industries (DPI) (2012). A Review of Rebuilding Options for the Victorian Abalone Fishery. State Government Victoria. Available from: https://www.environment.gov.au/system/files/pages/fb3d8568-f6d1-4fd4-bd78-180ea31d12eb/files/abalone-review.pdf

Director of National Parks (DNP) (2013). South-East Commonwealth Marine Reserves Network Management Plan 2013–23. Department of Environment Canberra, Available at: http://www.environment.gov.au/system/files/pages/de2de49a-7eed-4a70-bfbb-463f8d00f2ca/files/se-networkmanagement-plan2013-23.pdf.

Department of Transport and Planning (DTP) (2023). Maritime Heritage. Available from: https://www.heritage.vic.gov.au/heritage-listings/maritime-heritage. Department of Transport and Planning, Melbourne.

EMAC. (2020) About - Eastern Maar Aboriginal Corporation. https://easternmaar.com.au/about/

Georgeson, L., Stobutzki, I. & Curtotti, R. (eds) 2014, Fishery status reports 2013–14, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Huisman, J.M. (2000). Marine Plants of Australia. University of Western Australia Press.

Kimmerer W.J. & McKinnon A.D. (1984). Zooplankton Abundances in Bass Strait and WesteEnsco 102 Tasmanian Shelf Waters, March 1983.

Kirkman, H. (1997). Seagrasses of Australia, Australia: State of the Environment, Technical Paper Series (Estuaries and the Sea). Environment Australia, Commonwealth of Australia.

MESA. 2015. Mangroves of Australia – Distribution and Diversity. Marine Education Society of Australasia. Available from: http://www.mesa.edu.au/mangroves/mangroves01.asp.

McCauley, R.D. and Duncan, A.J. 2001. Marine Acoustic Effects Study, Blue Whale Feeding Aggregations, Otway Basin, Bass Strait Victoria, Centre for Marine Science and Technology, Curtin University March 2001 For Ecos Consulting

Native National Title Tribual (NNTT) (2016). Search National Native Title Register. Available from: http://www.nntt.gov.au/searchRegApps/NativeTitleRegisters/Pages/Search-National-Native-Title-Register.aspx

NOO (2002). Ecosystems – Nature's diversity: The South-east Regional Marine Plan Assessment Reports. National Oceans Office. Hobart.

NOO. (2002a). Sea Country – an Indigenous perspective. The South-east Regional Marine Plan. National Oceans Office. Hobart.

NOPSEMA (2021) Decommissioning Compliance Strategy.

Parks Victoria (1998). The Port Campbell National Park and Bay of Islands Coastal Park Management Plan. Parks Victoria, Melbourne. Available from: http://parkweb.vic.gov.au/explore/parks/port-campbell-national-park

Parks Victoria (2002). Wilsons Promontory National Park Management Plan. Parks Victoria, Melbourne. Available from: https://parkweb.vic.gov.au/__data/assets/pdf_file/0006/313458/Wilsons-Promontory-National-Park-Managemetn-Plan.pdf

Parks Victoria (2003). Cape Liptrap Coastal Park Management, Parks Victoria, Melbourne. Available from: http://parkweb.vic.gov.au/explore/parks/cape-liptrap-coastal-park

Parks Victoria (2005a). Corner Inlet Marine National Park Management Plan, Parks Victoria, Melbourne

Parks Victoria (2006a). Bunurong Marine National Park. Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve: Management Plan July 2006. Victoria.

Parks Victoria (2006b). Twelve Apostles Marine National Park and The Arches Marine Sanctuary Management Plan. Parks Victoria, Melbourne. Available from: http://parkweb.vic.gov.au/__data/assets/pdf_file/0020/313445/Twelve-Apostles-Marine-National-Park-and-The-Arches-MS-Management-Plan.pdf

Parks Victoria (2007a). Marengo Reefs Marine Sanctuary Management Plan, Parks Victoria, Melbourne. Available from: http://parkweb.vic.gov.au/__data/assets/pdf_file/0003/313347/Marengo-Reef-Marine-Sanctuary-Management-Plan.pdf

Parks Victoria (2019b). Port Campbell National Park. Available from: https://www.parks.vic.gov.au/places-to-see/parks/port-campbell-national-park

Parks Victoria and DSE (2009). Caring for Country — The Otways and You. Great Otway National Park and Otway Forest Park Management Plan, Parks Victoria and DSE, Melbourne. Available from: http://parkweb.vic.gov.au/explore/parks/great-otway-national-park

Patterson, H., Georgeson, L., Stobutzki, I. & Curtotti, R. (ed) 2015, Fishery status reports 2015, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 3.0.

Patterson, H., Noriega, R., Georgeson, L., Stobutzki, I. & Curtotti, R. (2016). Fishery status reports 2016, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 3.0.

Patterson, H., Noriega R., Georgeson, L., Larcombe, J. and Curtotti, R. (2017). Fishery status reports 2017, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, H., Larcombe, J., Nicol, S. and Curtotti, R. (2018). Fishery status reports 2018, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, H., Willliams, A., Woodhams, J. and Curtotti, R. 2019, Fishery status reports 2019, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, H., Larcombe, J., Woodhams, J. and Curtotti, R. 2020, Fishery status reports 2020, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, H, Bromhead, D, Galeano, D, Larcombe, J, Woodhams, J and Curtotti, R. (2021). Fishery status reports 2021, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0. https://doi.org/10.25814/vahf-ng93.

Patterson, H, Bromhead, D, Galeano, D, Larcombe, J, Timmiss, T, Woodhams, J and Curtotti, R. (2022). Fishery status reports 2022, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0. https://doi.org/10.25814/gx9r-3n90.

Ports Australia (2020) Trade Statistics Financial Year 2018 – 2019. https://www.portsaustralia.com.au/resources/trade-statistics

Victoria State Government (2016). Marine Pests and Disease, Abalone Disease, Background and Impact. Available from: http://agriculture.vic.gov.au/fisheries/policy-and-planning/marinepests-and-diseases/abalone-disease/background-and-impact

Watson C.F. and Chaloupka M.Y. (1982). Zooplankton of Bass Strait: Species Composition, Systematics and Artificial key to Species. Tasmanian Institute of Marine Science Technical Report No. 1.

10 Document information and history

Document custodian group

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