Gippsland Offshore Operations

Environment Plan Summary
VICPL31(V)

CONTROLLED DOCUMENT

(VGB-EN-EMP-0002)

Revision 0 – March 2019

Table of Contents

Tables

Figures

Document Control

Ownership of this document remains within the Cooper Energy Pty Ltd Projects department. Any updates, technical and /or errata, and the subsequent re-distribution of this document remains the responsibility of its author.

Document Revision and Amendment

Rev	Date	Details	Author	Reviewer	Approver
0	1/03/2019	Issued to DJPR	GLE	OGW	IM

Approvals

This Document has been approved by Cooper Energy for the Gippsland Offshore Operations.

Name	Signature	Date
Iain MacDougall General Manager Operations Cooper Energy Limited		1/3/2019

Acronyms and Abbreviations

Acronym	Description
ADIOS	Automated Data Inquiry for Oil Spills
AHS	Australia Hydrological Service
ALARP	As low as reasonably practicable
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute
COE	Cooper Energy
EMBA	Environment that May be Affected
ERR	Earth Resources Regulation
HDD	Horizontal directional drilling
HSEC	Health, Safety, Environment and Community
IMCRA	Integrated Marine and Costal Regionalisation of Australia
IMR	Inspection, maintenance and repair
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation
LEFCOL	Lakes Entrance Fishermen's Society Co-operative Limited
LOC	Loss of Containment
LOWC	Loss of Well Control
MDO	Marine Diesel Oil
MEG	Mono-ethylene Glycol
MoC	Management of Change
MS	Management System
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Petroleum Safety and Environmental Management Authority
OPEP	Oil Pollution Emergency Plan
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage Environmental Regulations
OSMP	Operational and Scientific Monitoring Plan
OWR	Oiled Wildlife Response
PLEM	Pipeline end manifold
PTS	Permanent Threshold Shift

Acronym	Description
RAMSAR	Convention on Wetlands of International Importance especially as Waterfowl Habitat
ROV	Remotely Operated Vehicle
SA	South Australia
SDFV	Scuba Divers Federation of Victoria
SETFIA	South-East Trawl Fishing Industry Association
SIV	Seafood Industry Victoria
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSF	Sustainable Shark Fishing Inc
SUTU	Subsea umbilical termination unit
TEC	Threatened Ecological Community
UNEP	United Nations Environment Programme
VRLA	Victorian Rock Lobster Association
WOMP	Well Operations Management Plan

Units

Unit	Description
‘	Minutes
“	Seconds
dB	Decibel
hrs	Hours
kHz	Kilohertz
km	Kilometres
km^2	Kilometres Squared
L	Litres
m	metres
m^2	Metres Squared
m^3	Metres Cubed
MMscfd	Million standard cubic feet per day

Unit	Description
º	Degrees
ºC	Degrees Celsius
ppb	Parts per Billion
µPa	Micro Pascals

1 Introduction

Cooper Energy Limited (Cooper Energy) holds a 100% interest and is the operator of the Gippsland assets in the Bass Strait, including:

- Patricia-Baleen (PB) Gas Field (Production Licence VIC/L21) and pipeline (Pipeline Licences VIC/L31 and VIC/L31(V));
- Sole Gas Field (Production Licence VIC/L32) and pipeline (Pipeline Licences VIC/PL006401 and VIC/PL43); and
- Basker Manta Gummy (BMG) (Retention Licences VIC/RL13, VIC/RL14 and VIC/RL15).

Figure 1-1 provides the location of these permits and fields.

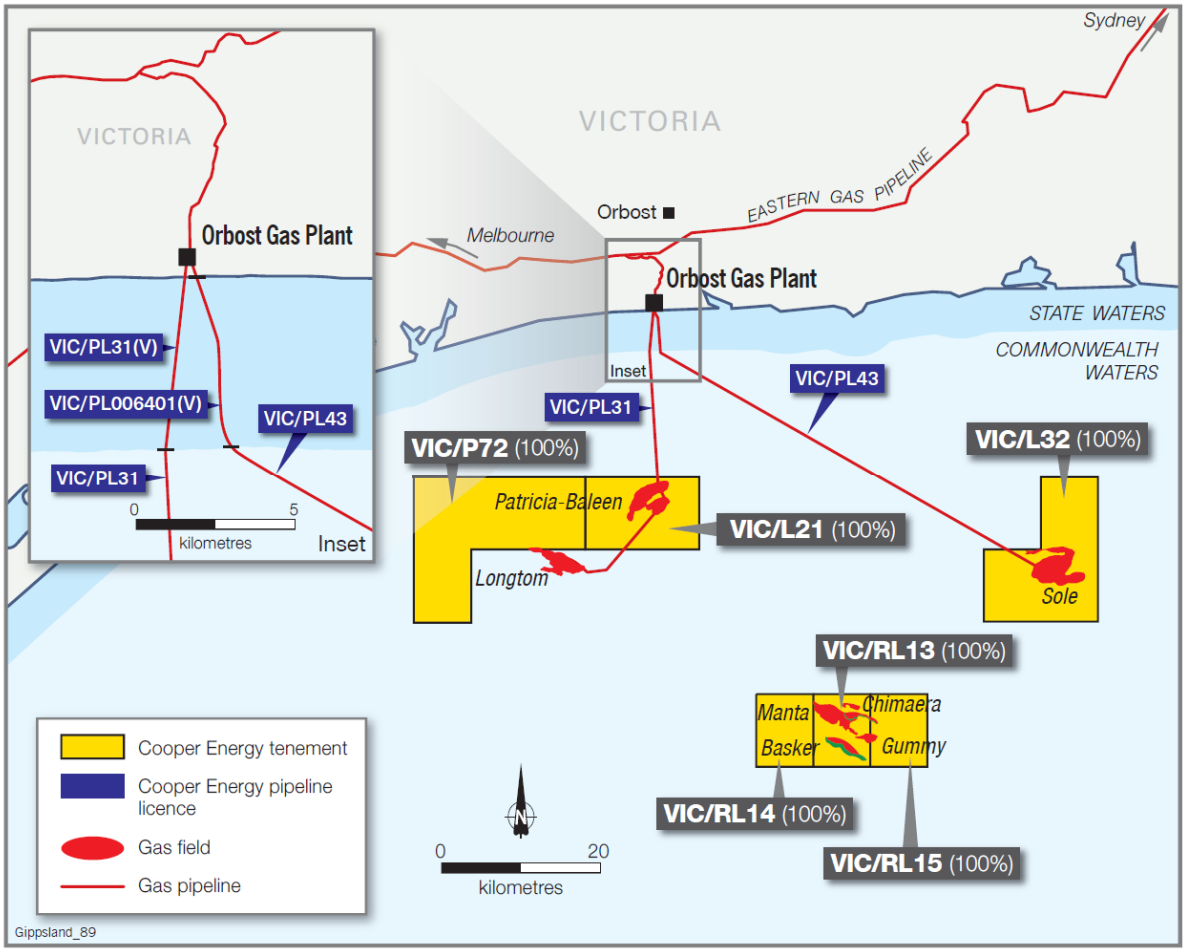

Figure 1-1 Location of Gippsland Offshore Operations Permits

1.1 Titleholder Details

Table 1-1 provides the details of titleholders and liaison person for the titles within which the petroleum activity will take place.

Table 1-1: Details of Titleholder and Liaison Person

Title and Titleholder	Titleholder Details	Liaison Person
Cooper Energy (PBF) Pty Ltd A.B.N.: 43 615 354 982 Production Licence VIC/L21 Pipeline Licences: VIC/PL31 VIC/PL31(V)	Level 8, 70 Franklin Street Adelaide, SA 5000 (08) 8100 4900	Iain MacDougall General Manager Operations Cooper Energy Limited Level 8, 70 Franklin St, Adelaide, SA, 5000 Phone: (08) 6556 2101 Email: iainm@cooperenergy.com
Cooper Energy (Sole) Pty Ltd A.B.N.: 86 613 951 429 Production Licence VIC/L32 Pipeline Licences: VIC/PL006401(V) VIC/PL43		
Cooper Energy Limited A.B.N.: 93 096 170 295 Retention Licences: VIC/RL13 VIC/RL14 VIC/RL15		

2 Location of the Activity

2.1 Overview

2.1.1 Location

The Gippsland Offshore Operations assets are in Commonwealth and State waters off Victoria's south-west coast (Figure 1-1). Assets are located within the following Licence areas:

- BMG field and associated infrastructure in VIC/RL13, VIC/RL14 and VIC/RL15, approximately 55 km from Cape Conran, Victoria;
- PB gas field and associated infrastructure in VIC/L21, 25 km south of Marlo in East Gippsland;
- PB gas pipeline and umbilical in VIC/PL31 and VIC/PL31 (V), a 24 km subsea pipeline and umbilical cable connecting the Patricia-2 and Baleen-4 wells to the Orbost Gas Plant;
- Sole gas field and associated infrastructure in VIC/L32, 40 km south of Bemm River, Victoria; and.
- Sole gas pipeline and umbilical in VIC/PL43 and VIC/PL006401(V), a 65 km subsea pipeline and umbilical connecting the Sole-3 and Sole-4 wells to the Orbost Gas Plant.

2.1.2 Operational Area

The Operational Area for the activity is the area where activities will take place and will be managed under this EP. The Operational Area has been defined as 500 m on either side of the Sole and PB pipelines and 500 m around the Sole, PB and BMG wells and subsea infrastructure.

The Operational Area, in some cases, is larger than the Petroleum Safety Zones (PSZs) that are in place for the Gippsland Offshore Operations infrastructure (Table 2-2).

Table 2-1: Gippsland Offshore Operations Infrastructure Petroleum Safety Zones

Asset	Infrastructure	Distance	Gazette Notice
BMG	Basker-6 (ST1) well	360 m	A443819
BMG	BMG field infrastructure	500 m	A443819
BMG	BMG exposed flowline	300 m	A443819
Sole	Pipeline End Manifold (PLEM) for Sole 3 well and Sole 4 well	500 m	A601713
PB	Baleen-4 well and Partricia-2 well	500 m	A528370

2.2 Asset Description

2.2.1 BMG

The BMG Field Development during the period 2005 – 2010 utilised the Crystal Ocean Floating Production Storage and Offloading (FPSO) to recover hydrocarbons through a series of subsea

wells tied back to the Crystal Ocean. In November 2010, ROC Oil (then Titleholder and Environmental Operator) and its joint venture partners determined that BMG production under its current operational configuration was not commercially viable and a decision was taken to enter a non-production phase (NPP).

A Manta Gas Development is currently being considered by Cooper Energy. Assessments have concluded that the existing BMG wells and facilities are not required for the Manta Gas Development. Consequently, Cooper Energy intends to abandon the existing BMG wells and oil development infrastructure. Current plans are to undertake these activities in two phases:

- Phase 1 – Plug and abandon the existing Basker and Manta wells.
- Phase 2 – Decommissioning of seabed infrastructure.

The abandonment activities are outside the scope of this EP. Phase 1 activities were originally scheduled for late 2018 and were to be undertaken in accordance with the NOPSEMA accepted BMG Well Abandonment (Phase 1) EP (BMG-EN-EMP-002). This work was subsequently delayed due to challenges gaining additional regulatory approvals. Planning is underway to re-schedule a future campaign once the appropriate regulatory approvals are in place.

2.2.1.1 Equipment Summary

The following wells and subsea equipment have been preserved on the seabed at BMG:

- All wells (Basker-2, Basker-3, Basker-4, Basker-5, Basker-6 (ST-1), Basker-7 and Manta-2A) and associated well-related equipment;
- Individual Subsea Control Modules (SCMs) for Basker-6 and Basker-7;
- The Basker-A Manifold (BAM);
- The three SCMs at the BAM;
- All interconnecting flexible flowlines, service lines and control umbilicals between the BAM and individual wellheads (be they production, gas injection, gas lift, electric or hydraulic leads). This also includes the 2” Manta gas lift line which runs from the BAM to Manta-2A well;
- The following static sections of flowlines up to the mid-line connection point:
  - The main 6” BAM-DTM Basker production flowline;
  - The main 6” DTM-BAM Basker injection flow line; and
  - The main 4” M2A-DTM production flowline.
- The following control umbilicals:
  - The static section of the main electro-hydraulic control umbilical previously running between the BAM and the FPSO; and
  - The hydraulic control umbilical (static section) previously running from M2A to the FPSO.
- The Basker-6 production flowline from the B6 wellhead to the BAM (trenched as far as practicable); and
- The Basker-6 control umbilical (trenched as far as practicable).

All remaining flowlines (production, gas-lift and gas reinjection), service chemical and control umbilicals remain connected (i.e. fixed) to existing equipment (wellheads/BAM).

During the BMG Deconstruction and Well Intervention Campaign (DWIC), the seven wells were shut-in and suspended.

2.2.1.2 Well Status, Isolation and Testing

Well isolation and subsea equipment testing operations were undertaken prior to the departure of the Crystal Ocean FPSO from the field or during the DWIC in 2012.

2.2.1.3 Production, Gas Injection and Gas Lift Flowlines

Prior to the Crystal Ocean FPSO leaving the field, the subsea infrastructure was subjected to a depressurization, flushing and inhibition program. A rated blind was placed on the end of the Basker Production, Basker Injection and Manta Production lines. This was tested and confirmed leak tight.

A total of approximately 179 m^3 of residual inhibited water is expected in the NPP flowlines.

2.2.1.4 Service Control Lines

The Service Control Lines to the SSSV and Completion Isolation Valve have been left filled with the water based hydraulic control fluid Transaqua HT2^{TM}. Transaqua HT2^{TM} is classified as a Non-Charmable Product (Initial Grouping - Group D) chemical under the North Sea OCNS and was a previously accepted chemical for use in the control lines in the BMG Phase 1 Oil Development operations.

Other chemical injection service lines have been displaced with uninhibited freshwater and capped.

2.2.2 PB

The Patricia and Baleen fields are significantly depleted and consist of dry gas. The Patricia-1 well is suspended and the Patricia-2 and Baleen-4 wells shut-in. The most recent use of the PB offshore pipeline was to transport Longtom gas and condensate rather than Patricia and Baleen gas production.

The Longtom gas field, pipeline, electrical system and associated control systems are outside the scope of this EP as Seven Group Holdings is the titleholder of the Longtom gas field and associated infrastructure.

2.2.2.1 Wells

The subsea system for Patricia-2 and Baleen-4 wells consists of wellheads with a subsea tree, fitted with production chokes, chemical injection facilities, subsea control modules and instrumentation, whereas the Patricia-1 system consists of a wellhead only. The Patricia-2 and Baleen-4 wells are currently shut-in at their subsea trees and valves have been confirmed closed. Control and monitoring of the wells is via an electro-hydraulic multiplexed control system supplied via umbilicals that connect the wells to the onshore facilities. Since an offshore electrical fault which occurred in May 2015, direct control and monitoring of the subsea system from the Orbost Gas Plant is not possible.

2.2.2.2 Pipeline

The Patricia-2 and Baleen-4 wells tie into the PB pipeline. The PB pipeline is connected to the Longtom pipeline via a PLEM which consists of a manual valve and a T-junction available for future connections. The T-junction has double isolation.

The PB pipeline system is isolated at the high integrity pipeline protection system (HIPPS) and at the onshore plant inlet. The HIPPS isolation valves failed-safe (closed) on loss of electrical signal following an electrical fault, thereby isolating the PB pipeline and a 17 km section of Longtom pipeline downstream of the HIPPS. The pipeline was then blown down to 230 kPa, and this pressure was monitored and proved to be holding static, indicating that the HIPPS valves were not passing. The HIPPS isolation valves will remain closed during the non-operation phase.

The pipeline was then injected with nitrogen to establish a pressure of 630 kPa. This positive pressure has been chosen to exceed the seawater head by 100 kPa to support the early identification of a passing valve and prove ongoing pipeline integrity.

The pipeline contains approximately 2,700 m^3 natural gas, 4,550 m^3 nitrogen, 5 m^3 Longtom condensate and 150 m^3 MEG/water mix (40:60).

2.2.2.3 Umbilical

The main umbilical consists of power/communication and chemical (MEG and hydraulic fluid) lines to and from the subsea infrastructure and the Orbost Gas Plant. The subsea main umbilical runs from the Orbost Gas Plant to the main umbilical termination assembly (MUTA), located adjacent to the Baleen-4 well. A smaller umbilical runs from the MUTA to the Patricia-2 well.

2.2.3 Sole

The Sole Development comprises two gas production wells connected to a production pipeline via a pipeline end manifold (PLEM) and tie-in spools. Communication and services for the offshore wells is provided by a control umbilical. The Sole production wells were drilled in 2018 and will commence production in 2019.

2.2.3.1 Wells

The Sole-3 and Sole-4 production wells consist of a subsea tree, fitted with production chokes, chemical injection facilities, subsea control modules and instrumentation.

The Sole-2 well is plugged and isolated from the reservoir with the wellhead still in place.

2.2.3.2 Pipeline

The Sole production pipeline is 300 mm (12 inch) in diameter carbon steel grade DNV 450. A PLEM is welded to the pipeline. The PLEM enables the production wells to be connected to the Sole production pipeline via rigid tie-in spool pieces. The PLEM is a gravity-based structure that is supported by a mudmat foundation.

Several tie-in spools and flying leads are required to connect the production wells to the Sole production pipeline and umbilical.

Pipeline external corrosion management is via anti-corrosion coating and sacrificial anodes designed to be maintenance free for the design life of the pipeline and externally visible for inspection by Remotely Operated Vehicle (ROV).

The production pipeline has been designed such that it will not be trenched but will lay on the seabed and does not require anchors.

Control of hydrate and internal corrosion will be by:hydrate inhibition and corrosion control. Though unlikely, if required hydrate dissipation and scale inhibition methods will be used.

2.2.3.3 Umbilical

The Sole umbilical consists of power/communication and chemical (MEG and hydraulic fluid) lines and runs from the subsea infrastructure to the Orbost Gas Plant. It is buried along the alignment and re-surfaces inside of the 500 m radius Petroleum Safety Zone (PSV) gazetted around the production wells.

The subsea umbilical termination unit (SUTU) acts to link the production wells (via subsea trees) to the Sole umbilical via flying leads and allows pressure to be monitored along with the flow of

hydrocarbons to be controlled. The SUTU is a gravity-based structure that is supported by a mudmat foundation.

2.3 Field Characteristics

2.3.1 BMG

Hydrocarbon from BMG infrastructure, in the unlikely event of a release will predominantly be gas with some condensate. Typical gas condensate properties are provided in Table 2-2.

Table 2-2: Basker Condensate Physical Properties (ROC 2010)

Physical Property	Value
API Gravity	65.5
Density (@11 ºC)	0.718
Dynamic Viscosity @ 40ºC)	0.465 cSt
Pour Point (ºC)	< - 8 ºC

2.3.2 PB

The Patricia and Baleen reservoirs are dry gas as provided in Table 2-3. The reservoirs are now substantially depleted.

The Longtom fluid physical characteristics are provided in Table 2-5. Approximately 5 m^3 of Longtom condensate remains in the offshore PB pipeline in its current non-operations phase.

Table 2-3: PB Reservoir Conditions (Santos 2014)

Parameter	Patricia-2	Baleen-4
Maximum Pressure at Reservoir Depth	400 psi	650 psi
Maximum temperature	120 °F	120 °F
Gas Specific Gravity	0.572	0.563
Condensate to Gas Ratio	<1 bbl/MMscf	<1 bbl/MMscf

Table 2-4: Longtom Condensate Physical Properties (Santos 2015)

		Longtom Condensate
API Gravity		51.2
Density@25oC g/ml		0.777
Dynamic Viscosity @ 20°C (cP)		1.081
GOR		10.85 stb/MMscf
Pour Point (°C)		-9 (when fresh)
Boiling Point Curve (% mass)	Volatiles (<180°C)	61.5
	Semi-volatile (180-265°C)	14.3
	Low Volatility (265-380°C)	21.1
	Residual (>380°C)	3.1
ITOPF Group		I

2.3.3 Sole

The Sole reservoir is a gas reservoir with very limited condensate observed or recovered during the well tests on Sole-2, Sole-3 and Sole-4. Physical characteristics of the Sole gas is provided in Table 2-6.

Table 2-5: Physical Characteristics of Sole Gas (Cooper Energy 2018)

Parameter	Sole
Maximum Pressure at Reservoir Depth	1147 psi
Maximum temperature	43 °C
Gas Specific Gravity	0.589
Condensate to Gas Ratio	<0.1 bbl/MMscf

2.4 Activities that have the potential to impact the environment

This section outlines the activities included in this EP which have the potential to result in environmental aspects or hazards, leading to impacts on receptors.

The activities included in this EP are:

- Sole operations;
- BMG and PB non-production;
- Inspection, maintenance and repair (IMR) of subsea infrastructure associated with the BMG, PB and Sole fields; and
- Vessel and ROV Operations.

3 Description of the Environment

3.1 Environment that May Be Affected

The Environment that May be Affected (EMBA) is based on the maximum credible hydrocarbon spill event that might occur during petroleum activities. For the activities under the Plan, the EMBA is based on hydrocarbon exposures above impact thresholds for ecological and social receptors for the accidental release of Marine Diesel Oil (MDO) from a vessel collision. Based on previous stochastic modelling the EMBA is expected to extend along waters off the eastern Victoria coast (Figure 3-1).

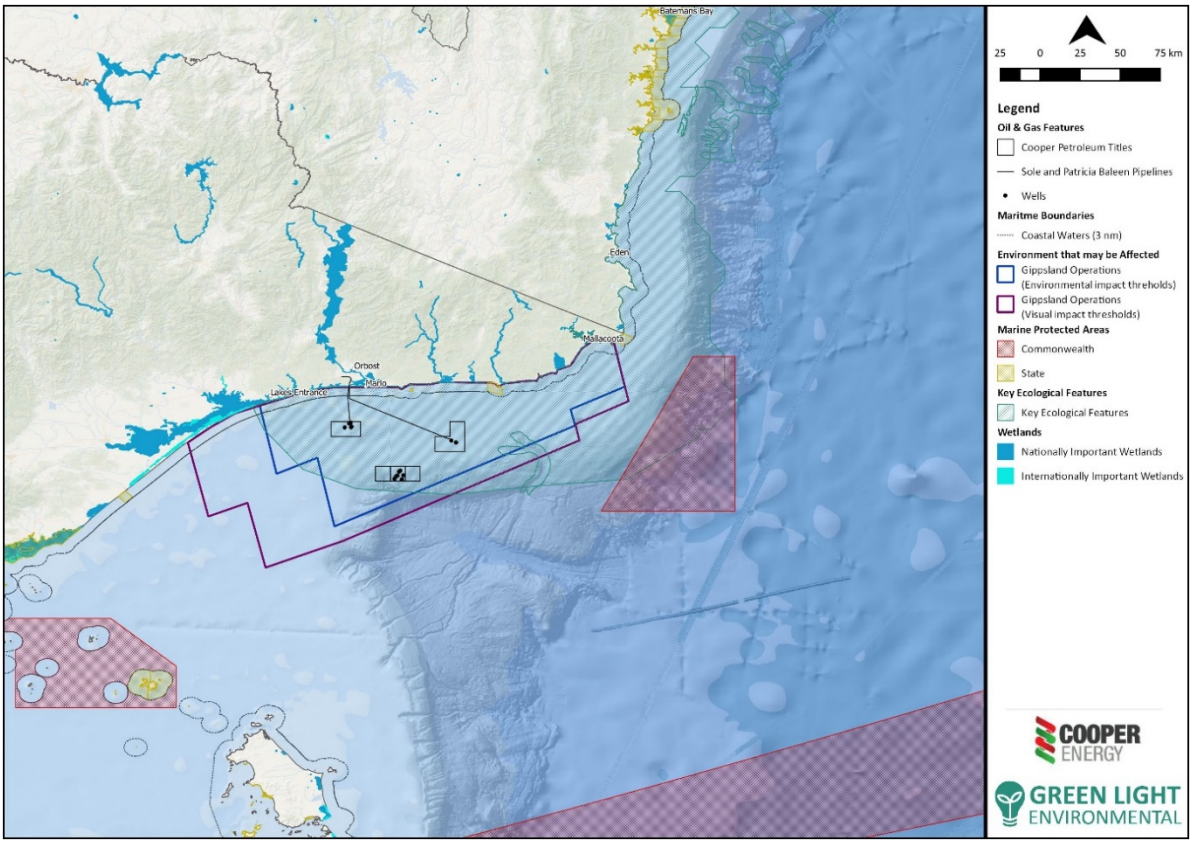

Figure 3-1: EMBA for the Gippsland Offshore Operations Activities

3.2 Regional Setting

The Gippsland Offshore Operations assets are in Commonwealth and State waters off Victoria's south-west coast in the Bass Strait.

The Gippsland assets are in water depths ranging from 9 to 263 m within the South-east Marine Region and the Twofold Shield Meso-scale Bioregion. The continental shelf within the Twofold Shelf region has a very steep inshore profile (0–20 m), with a less steep inner (20–60 m) to mid (60–120 m) shelf profile, and a generally flatter outer shelf plain (120–160 m) south-west of Cape Howe (IMCRA 1998). The wide shelf area is relatively featureless and flat (Santos 2015). The sediments on Twofold Shelf are poorly sorted, with a median of 92% sand and 8% gravel; they are composed of organic material, with a median of 64.5% calcium carbonate (IMCRA 1998). The seabed is comprised of fine to coarse sand and areas of shell (CEE Consultants 2003).

A Sole Development – Pipeline Route geoacoustic survey was undertaken in January of 2003 to characterise the bathymetry, seabed features, shallow geology, sediments and benthic habitat along the sole pipeline route (OMV 2003).

Key survey findings are:

- Bathymetry is generally gentle sloping between water depths of 14.7m approx. 200 m south of the Sole HDD beach crossing and 125.8 m at the Sole-3 location.
- Featureless seabed comprised of clays, silts, sands and gravel and some consolidated bedded sediments.
- Average seabed slopes along the proposed pipeline route do not exceed 0.25° (1:230). From the available bathymetry data, the seabed topography along the proposed pipeline route does not appear to contain significant cross slopes exceeding 10° (1:5.7).
- Poorly to well-defined megaripples and uneven surfaces were identified in a number of places along the proposed pipeline route. Megaripples are characterised by wavelength of less than 5 m to approximately 20 m, amplitudes less than 0.30 m and crest generally trending northeast suggesting a northwest to southeast primary current orientation.

Habitat characterisation surveys along the nearby PB pipeline route (OMV Australia 2002) showed a sand and shell/rubble seabed, with sparse epibiotic (e.g. sponges) coverage, with no reef systems (OMV Australia 2002). Similarly, surveys for the BMG wells (approximately 135 - 265 m water depth) note a featureless seabed. There has been extensive demersal fishing activity in the area, so seabed biota is expected to be modified from trawling and netting activities (CEE Consultants 2003).

A video survey undertaken along the PB pipeline in 2003 (CEE Consultants 2003) indicates that there are four general habitat associations on the seabed along the pipeline route. Large epibiota are very sparse, with extensive areas of sandy and shell/rubble seabed being devoid of large epibiota except for introduced screw shells and sponges. The habitats and associated biota are described below:

1. Medium sand and shell grit – extensive areas with pronounced sand waves. Epibiota was generally sparse to relatively commonly occurring sea pens and occasional sponges and stalked colonial ascidians. Sea pens were common in water depths of 22 to 27 m.
2. Shell accumulations – large patches of seabed comprised of old large shells, predominantly bivalves and scallops, with New Zealand screw shells present in large numbers. The proportion of sand ranged between zero and 20% cover.
3. Sponge garden – a small and distinct area of large sponges and bryozoans occurs at about 50 m water depth. The sponges varied in form and colour and included fans, spheres, massives, cups and fingers. Bryozoans included lace-like corals, concertina fans, perforated rigid sheets and fern-like branches. These associations indicate that although the seabed is comprised predominantly of sand and shell grit, it is stable enough to allow these associations to grow. Schools of jackass morwong, butterfly perch and individual gurnard and leatherjackets were attracted to the sponge garden.
4. Introduced NZ screw shell aggregations – the NZ screw shell (*Maoricolpus roseus*) was common in the survey area, generally in water depths greater than 40 m, sometimes forming dense beds covering 100% of the seabed.

Based on the above survey information, it is expected that the benthic habitat in the offshore Operational Area, is comprised of sandy substrate, sparse epifauna (e.g. sponges) and infauna.

Wave energy in this bioregion is relatively low. Water temperatures are also generally warmer than elsewhere on the Victorian open coast due to the influence of the East Australian Current (Parks Victoria 2003).

The coast is dominated by dunes and sandy shorelines, with occasional rock outcrops; and there are extensive areas of inshore and offshore soft sediments habitat (Barton et al. 2012). This region also has occasional low-relief reef immediately beyond the surf zone (Parks Victoria 2003).

3.3 Ecological and Social Receptors

The following tables show the presence of ecological (Table 3-1) and social (Table 3-2) receptors that may occur within the Operational Area and EMBA. Examples of values and sensitivities associated with each of the ecological or social receptors have been included in the tables. These values and sensitivities have been identified based on:

- Presence of listed threatened or migratory species or threatened ecological communities identified in the EPBC Protected Matter searches.
- Presence of BIAs and habitats critical to the survival of the species.
- Presence of important behaviours (e.g. foraging, roosting or breeding) by fauna, including those identified in the EPBC Protected Matter searches.
- They provide an important link to other receptors (e.g. nursery habitat, food source, commercial species).
- They provide an important human benefit (e.g. recreation and tourism, aesthetics, economic benefit).

Table 3-1: Presence of Ecological Receptors within the Operational Area and the EMBA

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
Habitat	Shoreline	Rocky	• Foraging habitat (e.g. birds) • Nesting or Breeding habitat (e.g. birds, pinnipeds) • Haul-out sites (e.g. pinnipeds)	-	Not present The Operational Area does not include the onshore environment.	✓	Present The coastal environment within the EMBA is comprised predominately of sandy shores with sections of rocky outcrops. Each of these shoreline types has the potential to support different flora and fauna assemblage due to the different physical factors (e.g. waves, tides, light etc.) influencing the habitat; for example: • Australian fur-seals are known to use rocky and sandy shores for haul-out and/breeding. • Birds species may use sandy or rocky areas for roosting and breeding sites. • Turtle species may use sandy area for nesting. • Rocky coasts can provide a hard substrate for sessile invertebrate species (e.g. barnacles, sponges etc) to attach to. • Artificial structures (e.g. groynes, jetties) while built for other purposes (e.g. shoreline protection, recreational activities) can also provide a hard
		Sandy	• Foraging habitat (e.g. birds) • Nesting or Breeding habitat (e.g. birds, pinnipeds, turtles) • Haul-out sites (e.g. pinnipeds)	-		✓	
		Artificial structure	• Sessile invertebrates	-		✓	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
							substrate for sessile invertebrates to attach to.
	Mangroves (Dominant Habitat)[1]	Intertidal/subtitle habitat, mangrove communities	• Nursery habitat (e.g. crustaceans, fish) • Breeding habitat (e.g. fish)	-	Not present The Operational Area does not include the onshore environment.	-	Not expected to be present Mangrove dominated habitat is not identified in the EMBA. Whilst, mangroves have been recorded in all Australian states except Tasmania. Mangrove habitat nearshore along the Victorian coast are distributed in South Gippsland around the French Island National Park and coast around Port Welshpool. Dominant mangrove habitat from the NISB Habitat Classification Scheme are not present in the EMBA. The closest Mangrove dominated habitat occurs in southern NSW, ~25 km north of the EMBA boundary.
	Saltmarsh (Dominant Habitat)	• Upper intertidal zone, Saltmarsh habitat, habitat for fish and benthic communities	• Nursery habitat (e.g. crustaceans, fish) • Breeding habitat (e.g. fish)	-	Not present The Operational Area does not include the onshore environment.	✓	Present Saltmarsh are identified in the EMBA. Saltmarsh habitat are widespread along the Australian coast and mostly occur in the upper intertidal zone. Saltmarsh dominated habitat with greater than 10% coverage of saltmarsh occurs along

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
							most of the coastline of the EMBA in Victoria. In the broader region outside of the EMBA, it occurs at western Port Phillip Bay, northern Western Port, within the Corner Inlet-Nooramunga (Figure 3.5, Addendum 1). Saltmarsh environments are much more common in northern Australia (e.g. Queensland), compared to the temperate and southern coasts (i.e. New South Wales, Victoria, Tasmania) (Boon et al. 2011).
	TEC: Subtropical and Temperate Coastal Saltmarsh	• Upper intertidal zone, Saltmarsh habitat, habitat for fish and benthic communities	• Nursery habitat (e.g. crustaceans, fish) • Breeding habitat (e.g. fish)	-	Not present The Operational Area does not include the onshore environment.	✓	Likely to occur. The 'Subtropical and Temperate Coastal Saltmarsh' is listed as a vulnerable Threatened Ecological Community (TEC) under the EPBC Act, and it's known distribution includes the southern and eastern coasts of Australia (Figure 3.7, Addendum 1). Ecological community consists mainly of salt-tolerant vegetation (halophytes) including: grasses, herbs, sedges, rushes and shrubs (TSSC 2013a). TEC environments

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
							are more common in northern Australia (Queensland), compared to the temperate and southern coasts (New South Wales, Victoria, Tasmania) (Boon et al. 2011).
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Rainforest and coastal vine thickets	• Provides habitat for flora and fauna • Coastal buffer against erosion	-	Not present The Operational Area does not include the onshore environment.	✓	Present The 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia' is listed as a critically endangered TEC under the EPBC Act. The ecological community is a complex of rainforest and coastal vine thickets on the east coast of Australia, including the area from Cape York Peninsula to the Gippsland Lakes in Victoria.
	Soft Sediment	Predominantly unvegetated soft sediment substrates	• Key habitat (e.g. benthic invertebrates)	✓	Present The Operational Area is located on the flat outer shelf plain of the Twofold Shelf and inshore soft sediment habitat. The benthic habitat within the Operational Area is expected to include predominantly sandy substrate with occasional low-relief reef in nearshore waters (Section 3.5, Addendum 1). The sediments on Twofold Shelf are poorly sorted, with a median of 92% sand and 8% gravel; they are	✓	Present Unvegetated soft sediments are a widespread habitat in both intertidal and subtidal areas, particularly in areas beyond the photic zone. The Gippsland Basin is composed of a series of large sediment flats, interspersed with small patches of reef, bedrock and consolidated sediment.

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities		Operational Area[1]		EMBA[2]
					composed of organic material, with a median of 64.5% calcium carbonate.		
	Seagrass	Seagrass meadows	• Nursery habitat (e.g. crustaceans, fish) • Food source (e.g. fish, turtles)	-	Not present The closest seagrass dominated habitat is present around Lakes Entrance in nearshore waters. Seagrass was not identified in the Sole or PB pipeline survey, and thus seagrass.	✓	Present Seagrass dominated habitat occurs in Lakes Entrance and extends along the Gippsland coast. Refer Addendum 1 - Table 3.12. In East Gippsland, seagrass meadows are common in sheltered bay environments or around small offshore islands. Species may include *Amphibolis antartica*, *Halophila australis*, *Heterozostera tasmanica*, *Posidonia australis*, *P. angustifolia*, and *Zostera muelleri*.
	Algae	Macroalgae	• Nursery habitat (e.g. crustaceans, fish) • Food source (e.g. birds, fish)	-	Not present The Operational Area does not include the nearshore intertidal and tidal zones where macroalgal communities may be present. The Operational Area is not a dominant macroalgae habitat based on the national mapping available from OzCoasts (2015).	✓	Present Benthic microalgae are ubiquitous in aquatic areas where sunlight reaches the sediment surface. Macroalgae communities are generally found on intertidal and shallow subtidal rocky substrates. They are not common as a dominant habitat type in East Gippsland but do occur in mixed reef environments. Species may include

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
							bull kelp and other brown algae species.
	TEC: Giant kelp marine forests of SE Australia	Kelp	• Primary producer habitat • Nursery habitat (e.g. crustaceans, fish) • Food source (e.g. birds, fish)	-	Not present (Section 3.7.3 – Addendum 1).	✓	May occur The 'Giant Kelp Marine Forests of South East Australia' is listed as an endangered TEC under the EPBC Act and may occur within the EMBA. The ecological community is characterised by a closed to semi-closed surface or subsurface canopy of *Macrocystis pyrifera*. This ecological community occurs on rocky substrate; some patches may occur in Victoria or northern Tasmania (Section 3.7.3 - Addendum 1).
	Coral	Hard and soft coral communities	• Nursery habitat (e.g. crustaceans, fish) • Breeding habitat (e.g. fish)	✓	Present Soft coral was identified in the PB pipeline survey at 50 m water depth and is expected to have sparse presence in the Operational Area.	✓	Present Soft corals can be found at most depths throughout the continental shelf, slope and off the slope regions, to well below the limit of light penetration. Soft corals (e.g. sea fans, sea whips) occur as part of mixed reef environments in waters along the East Gippsland coast. Soft corals can occur in a variety of water depths.

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
Marine Fauna	Plankton	Phytoplankton and zooplankton	• Food Source (e.g. fish, whales, turtles)	✓	Present Phytoplankton and zooplankton are widespread throughout oceanic environments and is expected to occur in the Operational Area. Increased abundance and productivity can occur in areas of upwelling e.g. Upwelling East of Eden KEF, which intersects with the Operational Area (Section 3.9 – Addendum 1).	✓	Present Phytoplankton and zooplankton are widespread throughout oceanic environments; however increased abundance and productivity can occur in areas of upwelling e.g. Upwelling East of Eden KEF, which intersect with the EMBA.
	Seabirds and Shorebirds	Birds that live or frequent the coast or ocean	• Listed Marine Species	✓	Present 34 seabird and shorebird species (or species habitat) may occur within the Operational Area. Ten species of albatross are listed as potentially foraging in the area; no other important behaviours were identified for other seabird or shorebird species. The Operational Area intersects BIAs for: Antipodean albatross, Black-browed albatross, Buller's albatross, Campbell albatross, Common diving-petrel, Indian yellow-nosed albatross, Shy albatross, Wandering albatross, White-faced storm-petrel.	✓	Present 36 seabird and shorebird species (or species habitat) may occur within the EMBA; with breeding, foraging and roosting behaviours identified. The EMBA intersects foraging BIAs for a number of albatross (Antipodean albatross, Black-browed albatross, Buller's albatross, Campbell albatross, Common diving-petrel, Indian yellow-nosed albatross, Shy albatross, Wandering albatross, White-faced storm-petrel, Short-tailed Shearwater and the little penguin.
			• Threatened Species	✓		✓	
			• Migratory Species	✓		✓	
			• BIA	✓		✓	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities		Operational Area[1]		EMBA[2]
					Detailed existing environment description in Section 3.10 and Table 3.8 - Addendum 1.		Roosting and breeding for a variety of bird species, wader birds and terns, occurs in eastern Victoria. Detailed existing environment description in Section 3.10 and Table 3.8 - Addendum 1.
	Marine Invertebrates	Benthic and pelagic invertebrates	• Food Source (e.g. fish)	✓	Present Marine invertebrates may occur within the Operational Area. Epifauna is expected to be sparse given the water depths. Studies of infauna in shallower waters of east Gippsland has indicated a high species diversity and abundance. Infauna may also be present within the sediment profile of the Operational Area (Section 3.11 – Addendum 1). Commercially important species (e.g. Rock lobster, Giant crab) are unlikely to occur in the Operational Area as there are no low-relief rocky reef and intertidal areas. The threatened marine invertebrate species, Tasmanian Live-bearing Seastar, is not present in the Gippsland and therefore is not expected to be present within the Operation Area.	✓	Present A variety of invertebrate species may occur within the EMBA, including sponges and arthropods. Infauna studies along the Victorian coast showed high species diversity, particularly in East Gippsland. Commercially important species (e.g. Rock lobster, Giant crab) may occur within the EMBA. The threatened marine invertebrate species, Tasmanian Live-bearing Seastar, is not present in the Gippsland and therefore is not expected to be present within the EMBA.
			• Commercial Species	✓		✓	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
	Fish	Fish	• Commercial Species	✓	Present Commercial fish species may occur within the Operational Area, however, given the lack of suitable benthic habitat, their abundance is expected to be low.	✓	Present Commercial fish species may occur within the EMBA, including Pink Ling, and species of wrasse, flathead and warehou.
			• Threatened Species	✓	Present One threatened species of fish (Australian Grayling) is known to occur within the Operational Area (Section 3.12 – Addendum 1).	✓	Present Three threatened fish species (or species habitat) may occur within the EMBA: • Australian grayling • Black rock cod • Eastern dwarf galaxias
		Sharks and Rays	• Threatened Species	✓	Present Four shark species (or species habitat) may occur within the Operational Area: • Grey nurse shark • White shark • Mako shark • Porbeagle shark The Operational Area is within a distribution BIA for the White Shark. No habitat critical to the survival of the species or behaviours were identified.	✓	Present Five shark species (or species habitat) may occur within the EMBA: • Grey nurse shark • White shark • Mako shark • Porbeagle shark • Whale shark The White Shark has known aggregation areas within eastern Victoria waters; the EMBA intersects the distribution BIA for this species. Breeding behaviour is noted for the
			• Migratory Species	✓		✓	
			• BIA and habitat critical to the survival of the species	✓		✓	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities		Operational Area[1]		EMBA[2]
							White Shark in the EPBC Protected Matters search, however the breeding BIA is outside of the EMBA.
		Pipefish, seahorse, seadragons	• Listed Marine Species	✓	Present 27 syngnathid species (or species habitat) may occur within the Operational Area (Table 3.12 – Addendum 1). No important behaviours or BIAs have been identified.	✓	Present 27 syngnathid species (or species habitat) may occur within the EMBA. No important behaviours or BIAs have been identified.
	Marine Reptiles	Marine turtles	• Listed Marine Species	✓	Present Four marine turtle species (or species habitat) may occur within the Operational Area (Table 3.15 – Addendum 1): • Loggerhead turtle • Green turtle • Leatherback turtle • Hawksbill turtle No BIAs or habitat critical to the survival of the species were identified for marine turtles.	✓	Present Four marine turtle species (or species habitat) may occur within the EMBA. The EMBA is recognised in the EPBC Protected Matters search, as a foraging habitat for: • Loggerhead turtle • Green turtle • Leatherback turtle • Hawksbill turtle No BIAs or habitat critical to the survival of the species occur within the EMBA.
			• Threatened Species	✓		✓	
			• Migratory Species	✓		✓	
			• BIA and habitat critical to the survival of the species	–		✓	
	Marine Mammals	Seals and Sealions (Pinnipeds)	• Listed Marine Species	✓	Present Two species of pinniped (or species habitat) may occur within the	✓	Present Two pinniped species (or species habitat) may occur within the EMBA.

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
			• BIA	–	Operational Area; the Long-nosed Fur-seal and the Australian Fur-seal (Section 3.14.1 – Addendum 1). No BIAs or habitat critical to the survival of the species were identified for pinnipeds.	-	One species (Australian Fur-seal) has breeding behaviour identified; there is known breeding sites in eastern Victoria (e.g. The Skerries). No BIAs or habitat critical to the survival of the species occur within the EMBA.
		Whales	• Listed Marine Species	✓	Present 22 whale species (or species habitat) may occur within the Operational Area. Foraging behaviours were identified for some species (Sei, Fin and Pygmy Right Whale; Pygmy Blue Whale); no other important behaviours were identified (Section 3.14.2 – Addendum 1). The Operational Area intersects a distribution and a migration and resting on migration BIA for the Southern Right Whale and a foraging BIA for the Pygmy Blue Whale.	✓	Present 23 whale species (or species habitat) may occur within the EMBA. Foraging behaviours were identified for some species (Sie, Fin and Pygmy Right Whales); no other important behaviours were identified. The EMBA intersects a distribution and migration and resting on migration BIA for the Southern Right Whale and a foraging BIA for the Pygmy Blue Whale.
			• Threatened Species	✓		✓	
			• Migratory Species	✓		✓	
			• BIA	✓		✓	
		Dolphins	• Listed Marine Species	✓	Present	✓	Present Seven dolphin species (or species habitat) may occur within the EMBA. No important behaviours or BIAs have been identified.
			• Migratory Species	✓		✓	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
					Seven dolphin species (or species habitat) may occur within the Operational Area. No important behaviours or BIAs have been identified.		
	Marine pests		• Introduced marine species	✓	Present The introduced conical New Zealand Screw Shell (*Maoricolpus roseus*) was common in the Sole and PB pipeline corridors, generally in water depths greater than 40 m (Section 3.15 – Addendum 1).	✓	Present The introduced conical New Zealand Screw Shell (*Maoricolpus roseus*) was common in the Sole and PB pipeline corridors, generally in water depths greater than 40 m.

Notes:
1. Combination of an EPBC Protected Matters Search of the Operational Area with a 5 km buffer, and characteristics of the Gippsland environment, have been used to describe ecological receptors that may occur within the Operational Area.
2. Combination of an EPBC Protected Matters Search for the EMBA area, and characteristics of the Gippsland environment, have been used to describe ecological receptors that may occur within the EMBA.

Table 3-2: Presence of Social Receptors within the Operational Area and the EMBA

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
Natural System	Commonwealth Marine Area	Key Ecological Features	• High productivity • Aggregations of marine life	✓	Present The Operational Area intersects with one KEF: • Upwelling East of Eden: an area of episodic upwelling known for high productivity and aggregations of marine life, including Blue whales,	✓	Present Two KEFs intersect with the EMBA: • Big Horseshoe Canyon: a feature at the easternmost end of the Bass Canyon system; the hard substrates provide attachment sites for benthic flora and fauna, thus

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
					Humpback whales, seals, sharks and seabirds. Refer Section 4.1 - Addendum 1.		increasing structural diversity and creating sheltering habitat for benthic fishes. • Upwelling East of Eden: an area of episodic upwelling known for high productivity and aggregations of marine life, including Blue whales, Humpback whales, seals, sharks and seabirds.
		Australian Marine Park	• Aggregations of marine life	-	Not present	-	Not present
	State Parks and Reserves	Marine Protected Areas	• Aggregations of marine life	-	Not present	✓	Present Two State Marine Protected Areas intersect with the EMBA: • Beware Reef Marine Sanctuary: protects partially exposed granite reef that is home to abundant marine life and is a haul-out site for Australian and New Zealand Fur-seals. Forests of Bull kelp and the remains of a shipwreck also occur within the sanctuary. • Point Hicks Marine National Park: supports a range of habitats including granite subtidal reef, intertidal rock platforms and offshore sands. These substrates host varied benthic flora and fauna including macroalgae, sponges, and seafans; and a diverse invertebrate assemblage (e.g. seastars, sea urchins, abalone, and nudibrancs). Pelagic fish diversity is

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
							also high including schools of Butterfly Perth, Silver Sweep and Banded Morwongs.
	Wetlands of International Importance	Ramsar Wetlands	• Aggregation, foraging and nursery habitat for marine life	-	Not present	✓	Present A single RAMSAR wetland is located within (or adjacent to) the EMBA: • Gippsland Lakes
		Marine and Coastal Zone Wetlands of National Importance	• Aggregation, foraging and nursery habitat for marine life	-	• Not present	✓	Present Numerous wetlands of importance (with a coastal or marine connection) intersect with the EMBA. The two closest to the Cooper assets are: • Ewing Morass • Lake Corringle
Human System	Commercial Fisheries	Commonwealth-managed	• Economic benefit	✓	Present Six Commonwealth-managed fisheries have management areas that intersect the Operational Area: • Bass Strait Central Zone Scallop • Eastern Tuna and Billfish Fishery • Small Pelagic Fishery • Southern and Easter Scalefish and Shark Fishery • Southern Bluefin Tuna Fishery, and • Southern Squid Jig Fishery	✓	Present Six Commonwealth-managed fisheries have management areas that intersect with the EMBA: • Bass Strait Central Zone Scallop • Eastern Tuna and Billfish Fishery • Small Pelagic Fishery • Southern and Easter Scalefish and Shark Fishery • Southern Bluefin Tuna Fishery, and • Southern Squid Jig Fishery

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
					Fishing intensity data suggests that the Southern and Eastern Scalefish and Shark Fishery and the Southern Squid Jig Fishery actively fish in the Operational Area. Overall active fishing effort within the Operational Area is expected to be low given the lack of suitable benthic habitat features. Refer Section 4.4 - Addendum 1.		Fishing intensity data suggests that the Southern and Eastern Scalefish and Shark Fishery and the Southern Squid Jig Fishery actively fish in the EMBA.
		State-managed	• Economic benefit	✓	Present A number of State-managed fisheries have management areas that intersect with the Operational Area. Based on water depth and habitat present in the Operational Area the following are likely to be present: • Scallop fishery Fishing intensity data is not available; however, fishing effort within the Operational Area is expected to be low given the lack of suitable benthic habitat features. In particular, there was no recent fishing effort within the eastern zone of the Giant Crab fishery in Victoria.	✓	Present A number of State-managed fisheries have management areas that intersect with the EMBA: • Abalone fishery • Eel fishery • Giant crab fishery • Pipi fishery • Rock lobster fishery • Scallop fishery • Wrasse fishery • Sea urchin and turban shell restricted fishery

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]	EMBA[2]
				Refer Section 4.4 - Addendum 1.	Fishing intensity data is not available; however, it is possible that the Giant Crab, Rock Lobster, Scallop and Wrasse fisheries may be active within the EMBA. Refer Table 4.10 – Addendum 1.
				- The following State Fisheries are unlikely to fish in the Operational Area due to water depths and lack of species habitat. • Abalone fishery – up to 30 m water depth. No hard substrate within the Operational Area where abalone present. • Eel fishery - Victorian coastal river basins. • Giant crab fishery Giant crabs inhabit the continental slope at approximately 200 m depth. • Rock lobster fishery -water depths less than 100 m deep on rock habitat reef, which is not present in the Operational Area. • Sea Urchin fishery - up to 30 m water depth. No hard substrate within the Operational Area where sea urchin present. • Wrasse fishery -depth rang 1 – 160 m usually inhabit deep exposed rock reefs which are not present in the Operational Area.	

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]		EMBA[2]	
	Recreational Fisheries	State-managed	• Community • Recreation	✓	Present Recreational fishing may occur within the Operational Area. Most recreational fishing typically occurs in nearshore coastal waters (shore or inshore vessels) and within bays and estuaries. Recreational fishing activity is expected to be minimal in the Operational Area. Refer Section 4.5 – Addendum 1.	✓	Present Most recreational fishing typically occurs in nearshore coastal waters, and within bays and estuaries; offshore (>5 km) fishing only accounts for approximately 4% of recreational fishing activity in Australia. The East Gippsland waters have a moderate fishing intensity (relative to other areas within the South-East Marine Region).
	Recreation and Tourism	Various human activities and interaction	• Community • Recreation • Economic benefit	✓	Present Marine-based recreation and tourism may occur within the Operational Area, but activity is expected to be minimal given the proportion of the lease area that is within nearshore waters is relatively small and the are no seabed features. Refer Section 4.7 – Addendum 1.	✓	Present The Australian coast provides a diverse range of recreation and tourism opportunities, including scuba diving, charter boat cruises, and surfing. In East Gippsland, primary tourist locations include Marlo, Cape Conran, Lakes Entrance and Mallacoota. The area is renowned for its nature-based tourism, recreational fishing and water sports. Refer Section 4.7 – Addendum 1.
	Industry	Shipping	• Community • Economic benefit	✓	Present The south-eastern coast is one of Australia's busiest in terms of shipping activity and volumes. The Operational	✓	Present The south-eastern coast is one of Australia's busiest in terms of shipping activity and volumes. However, shipping

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities		Operational Area[1]		EMBA[2]
					Area does not coincide with major shipping routes. Refer Section 4.8 – Addendum 1.		routes typically occur only through the southern extent of the EMBA. There are no major ports within the EMBA, but minor ports do exist (e.g. Lakes Entrance) that support commercial and recreational fishing industries. Refer Section 4.8 – Addendum 1.
		Oil and Gas	• Economic benefit	-	Not present Petroleum activity within the Operational Area is Cooper operated assets covered in this EP. Refer Section 4.8.2 – Addendum 1.	✓	Present Petroleum infrastructure in Gippsland Basin is well developed, with a network of pipelines transporting hydrocarbons produced offshore to onshore petroleum processing facilities at Longford and Orbost.
	Heritage	Maritime	• Shipwrecks	–	Not present Refer Section 4.9 – Addendum 1.	✓	Present Two shipwrecks are within the EMBA: *Commissioner* (in 7m water depth) and *SS Federal* (in 20 m water).
		Cultural	• World Heritage Properties • Commonwealth Heritage Places • National Heritage Places	–	Not present.	–	Not present.
		Indigenous	• Indigenous use or connection	–	Not present Refer Section 4.9 – Addendum 1.	✓	Present

Receptor Group	Receptor Type	Receptor Description	Values and Sensitivities	Operational Area[1]	EMBA[2]
					The coastal area of south-east Australia was amongst the most densely populated regions of pre-colonial Australia. Through cultural traditions, Aboriginal people maintain their connection to their ancestral lands and waters. The Gunaikurnai, Monero and the Bidhawel (Bidwell) Indigenous people are recognised as the traditional custodians of the lands and waters within the East Gippsland Shire. The Gunaikurnai people have an approved non-exclusive native title area extending from West Gippsland in Warragul, east to the Snowy River and north to the Great Dividing Range; and 200 m offshore.

Notes:

1. Combination of an EPBC Protected Matters Search of the Operational Area with a 5 km buffer, and characteristics of the Gippsland environment, have been used to describe ecological receptors that may occur within the Operational Area.
2. Combination of an EPBC Protected Matters Search for the EMBA area, and characteristics of the Gippsland environment, have been used to describe ecological receptors that may occur within the EMBA.

4 Impact and Risk Assessment

Meaningful risk identification, analysis and evaluation requires effective impact and risk scoping. This section identifies the impacts and risks associated with environmental aspects which require assessment.

4.1 Environmental Aspect Identification

An environmental aspect is an element or characteristic of an activity, product, or service that interacts or can interact with the environment. Environmental aspects can cause environmental impacts.

All components of the petroleum activity relevant to this scope were identified and described in the Environment Plan. After describing the petroleum activity, an assessment was carried out to identify potential aspects. The outcomes of stakeholder consultation over a number of years also contributed to aspect identification. The environmental aspects identified for the petroleum activity are detailed in Table 4-1.

Based upon an understanding of the environmental aspects, relevant impacts or risks were defined. Ecological and social receptors identified with the potential to be exposed to an aspect and subsequent impacts or risks were then summarised enabling a systematic evaluation to be undertaken.

4.2 Impact and Risk Scoping

An environmental impact (or risk) is a change to the environment that is caused either partly or entirely by one or more environmental aspects. An environmental aspect can have either a direct impact on the environment or contribute only partially or indirectly to a larger environmental change. The relationship between environmental aspects and environmental impacts is one of cause and effect.

An Environmental Workshop (ENVID) was held to identify environmental impacts and risks associated with the petroleum activity and assess controls to ensure impacts and risk managed to ALARP and an acceptable level. The workshop was attended by environment and asset personnel. Following the impact assessment methodology, impacts and risks were evaluated to determine consequence to receptors, ALARP decision context, likelihood and residual risk level of the impact or risk. Control measures were identified, and an assessment of Acceptability was undertaken against the Cooper Energy Acceptability Criteria.

For most impacts identified, the workshop was able to determine that the agreed controls lowered the impact to ALARP and that the residual risk level was at an acceptable level. Where this was not possible in the workshop, further assessment was undertaken to determine the environmental consequence and assessed additional controls.

Table 4-2 to Table 4-5 provide the outcomes of the ENVID. Where further assessment was required, this is provided in Sections 4.3 and 4.4.

Environmental Performance Outcomes and Standards relevant to all impacts and risks have been defined.

Table 4-1 Activity – Aspect Relationships

	Physical Presence – Displacement of other marine users	Seabed Disturbance	Light Emissions	Underwater Sound Emissions	Atmospheric Emissions	Planned Discharges						Physical Presence – Collision with marine fauna	Accidental release		
						Subsea Operational Discharges	Cooling water and brine	Treated bilge	Sewage and greywater	Food waste	Introduction of IMS		Waste	Loss of Containment (hydrocarbons or chemicals)	Loss of Wall Control
Production and Non-Production															
Subsea infrastructure	x					x									
Sole Operations															
Valve control and testing						x									
Unplanned events														x	x
BMG and PB Non-Production															
Unplanned events														x	x
Inspection, Maintenance and Repair															
Inspection, maintenance and repair		x				x									
Span/scour rectification		x													
Support Operations															
Vessel operations	x	x	x	x	x		x	x	x	x	x	x	x	x	
ROV operations														x	

Table 4-2: Sole Operations Impact and Risk Scoping

Activity	Aspect	Impact / Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practice Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Valve control and testing	Planned Discharge - Subsea Operational Discharges	Change in water quality	Plankton Marine fauna	Discharges of hydraulic fluid will occur from two wells in 124 m water. Discharges will be of low volume (3 L per actuation) non-continuous and expected to disperse rapidly in the offshore environment. Given the small volumes and the low-toxicity fluids, discharges are expected to rapidly dissipate and dilute in the high energy environment of Bass Strait. Impacts to water quality are expected to be temporary and localised and thus will not impact on plankton and marine fauna that maybe transient within the Operational Area.	Minor	A	C1: Offshore Environmental Chemical Assessment Process C2: Monitoring of hydraulic fluid use	Full electric control system is not technically or commercially feasible on subsea tree systems. Use of seawater could lead to integrity issues. Valve closing is not as efficient with closed-loop systems.	Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
Unplanned Events	Accidental Release - LOC - Infrastructure	Change in water quality	**Further assessment required (Section 5.4).**									
	Accidental Release - LOWC	Change in water quality	**Further assessment required (Section 5.4.).**									

Table 4-3: BMG and PB Non-Production Impact and Risk Scoping

Activity	Aspect	Impact / Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Unplanned Events	Accidental Release - LOC - PB Infrastructure	Change in water quality	**Further assessment required (Section 5.4).**									
	Accidental Release - LOWC - PB	Change in water quality	**Further assessment required (Section 5.4).**									
	Accidental Release - LOC - BMG Infrastructure	Change in water quality	**Further assessment required (Section 5.4).**									
	Accidental Release - LOWC - BMG	Change in water quality	**Further assessment required (Section 5.4).**									

Table 4-4: IMR Impact and Risk Scoping

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Maintenance and repair activities Pipeline span rectification	Seabed Disturbance	Change in habitat	Benthic habitat Benthic Invertebrates	Areas of seabed may be disturbed from either direct placement of materials/infrastructure on the seabed or via smothering, caused by agitation and re-settling of seabed sediments. Areas disturbed would typically be within previously disturbed areas where infrastructure is already present. The predominant habitat within the Operational Area is sandy substrate with an area of soft corals identified in 50 m water depth along the PB pipeline. Benthic species of conservation or commercial value are unlikely in the Operational Area based on the sandy substrate. Impacts are expected to be localised and temporary with no long-term changes to habitat.	Negligible	A	C3: Offshore Scope of Work		Unlikely	**Low**	• Impacts well understood. • Low risk. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
		Change in water quality	Benthic Invertebrates	Activities may result in increased turbidity near the seabed, however no water column impacts are expected as the predominant substrate is sandy, hence less likely to become suspended in the water column. The use of grout bags could result in the leaching of chemicals near the seabed. Grout bags will use cement which is commonly used in the marine environment. Low toxicity cement will be utilised. Benthic species of conservation or commercial value are unlikely in the Operational Area based on the sandy substrate. Impacts are expected to be localised and temporary with no long-term changes to water quality.	Negligible	A	C1: Offshore Environmental Chemical Assessment Process		Unlikely	**Low**	• Impacts well understood. • Low risk. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
			Upwelling East of Eden KEF	The Operational Area is located within the Upwelling East of Eden KEF, an area of episodic upwelling known for high productivity and marine life. Activities may result in increased turbidity near the seabed, however, no water column impacts are expected as the predominant substrate is sandy, hence less likely to become suspended in the water column. The use of grout bags could result in the leaching of chemicals near the seabed. Grout bags will use cement which is commonly used in the marine environment. Low toxicity cement will be utilised. Impacts are expected to be localised and temporary and would not impact on the values and functions of the KEF.	Negligible							

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Maintenance and repair	Planned Discharge - Subsea Operational Discharges	Change in water quality	Plankton Marine fauna	Discharges of operational fluids during maintenance and repair may occur. Discharges will be of low volumes (< 10 L) non-continuous and expected to disperse rapidly in the offshore environment. Given the small volumes and the low-toxicity fluids, discharges are expected to rapidly dissipate and dilute in the high energy environment of Bass Strait. Impacts to water quality are expected to be temporary and localised and thus will not impact on plankton and marine fauna that maybe transient within the Operational Area.	Negligible	A	C1: Offshore Environmental Chemical Assessment Process C4: Campaign Risk Assessment		Unlikely	**Low**	• Impacts well understood. • Low risk. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable

Table 4-5: Support Operations Impact and Risk Scoping

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Vessel operations	Seabed Disturbance Anchoring	Change in habitat	Benthic habitat Benthic Invertebrates	Areas of seabed may be disturbed from anchoring in shallow waters (less than 10 m) where dynamic positioning cannot be used. Area of disturbance would be small (up to 100 m^2). The predominant habitat within the Operational Area up to 10 m water depth is sandy substrate. Benthic species of conservation or commercial value are unlikely in the Operational Area based on the sandy substrate. Impacts are expected to be localised and temporary with no long-term changes to habitat.	Negligible	A	C3: Offshore Scope of Work		Unlikely	**Low**	• Impacts well understood. • Low risk. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
Vessel operations	Atmospheric Emissions	Change in air quality	Birds	Offshore winds will rapidly disperse and dilute atmospheric emissions when they are discharged into the environment. The Operational Area overlaps foraging BIAs for a number of albatross and the Common diving-petrel. The impacts on air quality is predicted to be localised to the emission point and can be expected to be reduced to background levels close to the source. No habitat critical to the survival of birds occur within the Operational Area. Atmospheric emissions are not identified as a threat in the National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC	Negligible	A	C5: Marine Order 97: Marine Pollution Prevention – Air Pollution		Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the long term survival and recovery of albatross and giant petrel populations breeding and foraging	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
				2011) though climate change is, however, vessel emissions would not be significant enough to impact on climate change. Impacts from vessel atmospheric emissions will be localised and temporary; limited to the Operational Area.							as per the National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC 2011). • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	
			Coastal Settlements	There are no coastal settlements within the Operational Area or at a distance where impacts from air emissions would occur.	N/A							
Vessel operations	Light Emissions	Change in fauna behaviour	Birds	High levels of light can attract and disorientate birds. Light glow from the vessel is likely to be limited to the Operational Area and temporary in nature (days to weeks) depending on the activity. The Operational Area overlaps foraging BIAs for a number of albatross and the Common diving-petrel. The impacts on air quality is predicted to be localised to the emission point and can be expected to be reduced to background levels close to the source. No habitat critical to the survival of birds occur within the Operational Area. Light emissions are identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011). Impacts from vessel light emissions will be localised and temporary; limited to the Operational Area.	Negligible	A	None identified		Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the long term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011). • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
			Fish	High levels of light may attract fish which are then preyed upon. Light glow from the vessel is likely to be limited to the Operational Area and temporary in nature (days to weeks) depending on the activity. The threatened Australian grayling maybe present in the area; however, light is not identified as a threat to this species in the National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008). Commercial fish species may be present in the Operational Area but light from a vessel undertaking offshore activities would be the equivalent as for a fishing vessel, hence impacts to commercial fish species are unlikely.	Negligible	A	None identified		Remote	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of the Australian grayling as per the National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008). • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
											• No stakeholder objections or claims have been raised.	
			Marine turtles	Artificial light can disrupt turtle nesting and hatching behaviours. There are no turtle nesting beaches along the adjacent coastline to the Operational Area, therefore no impact is expected.	N/A							
Vessel operations	Planned Discharges: Cooling water Brine Treated bilge Sewage and greywater	Change in water quality	Plankton Fish (Bony fish, sharks and rays) Marine turtles Marine mammals	Waste water discharges can result in localised impact on water quality from increased temperature, salinity, nutrients, chemicals and hydrocarbons leading to toxic effects to marine fauna. Vessel waste water discharges would be of low volume during in-water activities of short duration (up to 3 weeks). 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 thus it is expected that any waste water discharges would disperse quickly over a small area. Juvenile lifecycle stages most vulnerable, however recovery will be rapid (UNEP, 1985). The threatened Australian grayling maybe present in the area. The National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008) identifies poor water quality as a threat to this species, however, this is associated with onshore waterways. Commercial fish species may be present in the Operational Area, however, as the discharge disperse quickly over a small area impacts are not predicted. Four threatened shark species may be present in the Operational Area. The Operational Area is also within the distribution BIA for Great White Shark, although no critical habitats or behaviours are present. Sharks will be transient through the area thus impacts are not predicted. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (Commonwealth of Australia 2013) does not identify vessel discharges or equivalent as a threat. No turtle BIAs are located within the Operational Area though listed and threatened species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) though not specifically from vessels. As these species would be transient in the area and impacts are predicted to be to be localised and temporary. Marine mammals can actively avoid plumes, limiting exposure. The Operational Area overlaps the Southern Right Whale migration and resting on migration BIA and the Pygmy Blue Whale foraging BIA. The Conservation Management Plan for the Southern Right Whale (Commonwealth of Australia 2012) and Conservation Management Plan for the	Minor	A	C1: Offshore Environmental Chemical Assessment Process C6: Protection of the Sea (Prevention of Pollution from Ships) Act 1983 C7: Preventative Maintenance System		Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of the Australian grayling as per the National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008). • Activity will not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017). • Activity will not impact the recovery of the White Shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (Commonwealth of Australia 2013). • Activity will not impact the recovery of the Blue Whale or the Southern Right Whale as per the Conservation Management Plan for the Blue Whale, 2015-2025 and Conservation Management Plan for the Southern Right Whale, 2011-2021. • Activity will not impact on the values and functions of the Upwelling East of Eden KEF. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
				Blue Whale (Commonwealth of Australia 2015) do not identify discharges from vessels as a threat to the recovery of these species.								
			Upwelling East of Eden KEF	Waste water discharges can result in localised impact on water quality from increased temperature, salinity, nutrients, chemicals and hydrocarbons leading to toxic effects to marine fauna. Vessel waste water discharges would be of low volume during in-water activities of short duration (up to 3 weeks). 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 thus it is expected that any waste water discharges would disperse quickly over a small area. The Operational Area is located within the Upwelling East of Eden KEF, an area of episodic upwelling known for high productivity and marine life. Impacts are expected to be localised and temporary and would not impact on the values and functions of the KEF.	Minor							
Vessel operations	Planned Discharge: Food waste	Change in fauna behaviour	Birds Fish	Periodic discharge of macerated food scraps 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 vessel during in-water activities of short duration (up to 3 weeks). The Operational Area overlaps foraging BIAs for a number of albatross and the Common diving-petrel. No habitat critical to the survival of birds occur within the Operational Area. Marine pollution is identified as a threat in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011), however, as the discharge would be sporadic and for a short duration marine pollution impacts or changes to behaviour is not expected. The threatened Australian grayling maybe present in the area. The National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008) identifies poor water quality as a threat to this species, however, this is associated with onshore waterways. Commercial fish species may be present in the Operational Area, however as the discharge would be sporadic and for a short duration changes to behaviour is not expected.	Minor	A	C8: Marine Order 95: Marine pollution prevention – garbage		Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of the Australian grayling as per the National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008). • Activity will not impact the long term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011). • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
Vessel operations	Planned Discharges: Food waste	Change in aesthetic value	Tourism	Sewage discharges will be rapidly diluted, with impacts limited to the Operational Area. No tourism expected within the Operational Area due to lack of features.	NA							

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
	Sewage and greywater		Coastal Settlements	There are no coastal settlements within the operational area.	NA							
Vessel operations	Underwater Sound Emissions: Continuous	Change in fauna behaviour	Fish (Bony fish, sharks and rays) Marine turtles	Vessels will emit noise from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment. Studies of underwater noise generated from propellers of support vessels when holding position indicate highest measured levels up to 182 dB re1µPa, with levels of 120 dB re 1µPa recorded at 3–4 km (Hannay et al. 2004). Popper et al. (2014) details that risks of mortality and potential mortal injury, and recoverable injury impacts to fish with no swim bladder (whale sharks) and turtles is low and that temporary threshold shift (TTS) in hearing may be a moderate risk near (10s of metres) the vessel. For fish with a swim bladder risks of mortality and potential mortal injury impacts is low with a cumulative exposure guideline for recoverable injury and TTS which is not applicable as there are not areas of site-attached species within the Operational Area. 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, whale sharks or turtles from moving away from the vessel. The threatened Australian grayling maybe present in the area. The National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008) does not identify noise impacts as a threat to this species. 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*) (Commonwealth of Australia 2013) does not identify noise impacts as a threat. Four marine turtle species (or species habitat) may occur within the Operational Area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) identified noise interference as a threat, however, disturbance impacts to individuals are predicted which will not impact on turtles at a population level.	Minor	A	None identified	None	Unlikely	Low	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of the Australian grayling as per the National Recovery Plan for the Australian Grayling *Prototroctes maraena* (DSE 2008). • Activity will not impact the recovery of the White Shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (Commonwealth of Australia 2013). • Activity will not impact the recovery of marine turtle species as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017). • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
			Seals (Pinnipeds)	Vessels will emit noise from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment. Studies of underwater noise generated from propellers of support vessels when holding position indicate highest measured levels up to 182 dB re1µPa, with levels of 120 dB re 1µPa recorded at 3–4 km (Hannay et al. 2004). Two species of pinniped (or species habitat) may occur within the Operational Area; the Long-nosed Fur-seal and the Australian Fur-seal. No BIAs or	Minor	A	C9: Wildlife (Marine Mammals) Regulations 2009	None	Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
				habitat critical to the survival of the species were identified for pinnipeds. Onset thresholds for TTS and permanent threshold shift (PTS) for seals for non-impulsive noise (vessels) suggested by NMFS (2018) are as cumulative sound exposure levels over a period of 24 hours. These cannot be compared to the sounds level recorded by Hannay et al. (2004) or McCauley (1998; 2004) which report sound pressure levels. However, based on there are no BIAs or critical habitat for pinnipeds within the Operational Area or within 4 km where vessel noise levels would dissipate to 120 dB re 1µPa (Hannay et al. 2004) which is the recommended threshold for behavioural disruption for continuous noise for marine mammals (NMFS 2013), impacts are likely to result in behavioural changes such as avoidance of the area rather than TTS or PTS impacts. Continuous vessel noise from this activity is not expected to be any higher than that generated by existing shipping traffic within the region. Temporary behavioural impacts to these species are not expected to result in a significant change to behaviours or natural movement that would result in further impact to individuals or local population levels.							• Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	
			Whales and dolphins	Vessels will emit noise from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment. Studies of underwater noise generated from propellers of support vessels when holding position indicate highest measured levels up to 182 dB re1µPa, with levels of 120 dB re 1µPa recorded at 3–4 km (Hannay et al. 2004). Seven dolphin species may occur within the Operational Area. No important behaviours or BIAs have been identified. 22 whale species (or species habitat) may occur within the Operational Area. Foraging behaviours were identified for some species (Sei, Fin and Pygmy Right Whale; Pygmy Blue Whale); no other important behaviours were identified. The Operational Area intersects a distribution and a migration and resting on migration BIA for the Southern Right Whale and a foraging BIA for the Pygmy Blue Whale. Onset thresholds for TTS and PTS for cetaceans for non-impulsive noise (vessels) suggested by NMFS (2018) are as cumulative sound exposure levels over a period of 24 hours. These cannot be compared to the sounds level recorded by Hannay et al. (2004) or McCauley (1998; 2004) which report sound pressure levels. Foraging behaviours and two BIAs are within the Operational Area or within 4 km where vessel noise levels would dissipate to 120 dB re 1µPa (Hannay et al. 2004) which is the recommended threshold for behavioural disruption for continuous noise for marine mammals (NMFS 2013). Thus, impacts are likely to result in behavioural changes such as avoidance of the area rather than TTS or PTS impacts.	Minor	A	C9: Wildlife (Marine Mammals) Regulations 2009 C10 EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	None	Unlikely	Low	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of the Blue Whale or the Southern Right Whale as per the Conservation Management Plan for the Blue Whale, 2015-2025 and Conservation Management Plan for the Southern Right Whale, 2011-2021. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
				The Conservation Management Plan for the Blue Whale and for the Southern Right Whale and Conservation Advice for the Sei Whale, Fin Whale and Humpback Whale identify noise interference as a threat. However, continuous vessel noise from this activity is not expected to be any higher than that generated by existing shipping traffic within the region. Temporary behavioural impacts to these species are not expected to result in a significant change to foraging behaviours or natural movement that would result in further impact to individuals or local population levels.								
			Fisheries	Impacts to commercial fish species are expected to be negligible, therefore no impacts to fisheries are expected.	NA							

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Vessel operations	Physical Presence – Collision with marine fauna	Injury/Mortality to fauna	Marine turtles Seals (Pinnipeds) Whales and dolphins (cetaceans)	Megafauna are most at risk from collision. Impacts will be limited to the Operational Area. Four marine turtle species (or species habitat) may occur within the Operational Area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) identified vessel strike as a threat. Two species of pinniped (or species habitat) may occur within the Operational Area; the Long-nosed Fur-seal and the Australian Fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds. 22 whale species (or species habitat) may occur within the Operational Area. Foraging behaviours were identified for some species (Sei, Fin and Pygmy Right Whale; Pygmy Blue Whale); no other important behaviours were identified. The Operational Area intersects a distribution and a migration and resting on migration BIA for the Southern Right Whale and a foraging BIA for the Pygmy Blue Whale. The Conservation Management Plan for the Blue Whale and for the Southern Right Whale and Conservation Advice for the Sei Whale, Fin Whale and Humpback Whale identify vessel strike as a threat. The occurrence of vessel strikes is very low with no incidents occurring during the activities to date associated with the BMG and PB operations and Sole Development. If an incident occurred, it would be restricted to individual fauna and not have impacts to local population levels.	Minor	A	C9: Wildlife (Marine Mammals) Regulations 2009 C10: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans		Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the recovery of marine turtle species as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017). • Activity will not impact the recovery of the Blue Whale or the Southern Right Whale as per the Conservation Management Plan for the Blue Whale, 2015-2025 and Conservation Management Plan for the Southern Right Whale, 2011-2021. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
Vessel operations	Physical Presence	Displacement of other marine users	Fisheries	Several fisheries may have an active presence in the Operational Area. Fishing effort data is not available but is expected to be low due to the lack of features within the Operational Area. During stakeholder consultation for the Sole Development concerns were raised regarding the loss of fishing grounds in relation to restrictions to fishing within the wells PSZ. However, for reasons of safety, equipment integrity and to other marine users, PSZ are considered a necessity. The PSZ is only a small area in comparison to the larger fishing grounds of the region. Fishing can be undertaken in all other areas of the Operational Area including the Sole and PB pipelines. The exclusion of fisheries from around a vessel when undertaking IMR or seabed survey activities will have a negligible consequence on fisheries catch as the area that is restricted is small in comparison to the area available for fishing and is for a period of days to weeks.	Minor	A	C11: Ongoing consultation	Removal of PSZ: PSZ around wells is a regulatory requirement.	Unlikely	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore will not have a significant impact to third parties. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • Stakeholder objections or claims have been raised and the area that is restricted is a regulatory requirement for ensuring safe operations.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
			Shipping	The Operational Area does not cross any major shipping routes. Shipping traffic within the Operational Area is low. Vessels are excluded from the PSZ around the wells. To date there has been no interactions with shipping.	Negligible							
Vessel operations	Accidental Release - Waste	Injury/Mortality to fauna	Birds Marine turtles Seals (Pinnipeds) Whales and dolphins (cetaceans)	There will be no transfer of waste from the vessel during the activity. Waste accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement. Impacts will be restricted in exposure and quantity and will be limited to individual fauna and not have impacts to local population levels. The Operational Area overlaps foraging BIAs for a number of albatross and the Common diving-petrel. No habitat critical to the survival of birds occur within the Operational Area. Marine debris is identified as a threat in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011), Four marine turtle species (or species habitat) may occur within the Operational Area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) identified marine debris as a threat. Two species of pinniped (or species habitat) may occur within the Operational Area; the Long-nosed Fur-seal and the Australian Fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds. 22 whale species (or species habitat) may occur within the Operational Area. Foraging behaviours were identified for some species (Sei, Fin and Pygmy Right Whale; Pygmy Blue Whale); no other important behaviours were identified. The Operational Area intersects a distribution and a migration and resting on migration BIA for the Southern Right Whale and a foraging BIA for the Pygmy Blue Whale. The Conservation Management Plan for the Blue Whale and for the Southern Right Whale and Conservation Advice for the Sei Whale, Fin Whale and Humpback Whale do not identify marine debri as threat.	Negligible	A	C8: Marine Order 95: Marine pollution prevention – garbage		Remote	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Activity will not impact the long term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011). • Activity will not impact the recovery of marine turtle species as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017). • Activity will not impact the recovery of the Blue Whale or the Southern Right Whale as per the Conservation Management Plan for the Blue Whale, 2015-2025 and Conservation Management Plan for the Southern Right Whale, 2011-2021. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable

Activity	Aspect	Impact/Risk	Affected receptor	Consequence Evaluation	Consequence	ALARP Decision Context	Good Practise Controls	Additional control measures considered	Likelihood	Residual Risk	Acceptability Assessment	Acceptability Outcome
Vessel Operations ROV Operations	Accidental Release - Minor Spill (hydrocarbon or chemical)	Change in water quality	Plankton Marine fauna	Minor spills < 200 L may occur from: • Vessel equipment, bulk storage or package chemical leak (deck spill). • ROV hydraulic hose leak. Given the small volumes and the low-toxicity hydrocarbons and chemicals that could be discharged, minor spills are expected to rapidly dissipate and dilute in the high energy environment of Bass Strait. Impacts to water quality are expected to be temporary and localised and thus will not impact on plankton and marine fauna that maybe transient within the Operational Area.	Negligible	A	C12: ROV pre-dive Inspections C13: Containment C14: Shipboard Marine Pollution Emergency Plan (SMPEP)	Electric ROV – not always available	Remote	**Low**	• Impacts well understood. • Residual risk is Low. • Consequence level is below 4, therefore no potential to affect biological diversity and ecological integrity. • Activity will not result in serious or irreversible damage. • Good practise controls defined and implemented. • Cooper Energy HSEC MS Standards and Risk Control Processes have been identified. • No stakeholder objections or claims have been raised.	Acceptable
Vessel operations	Introduction of Invasive Marine Species	Change in ecosystem dynamics	**Further assessment required (Section 5.3).**									
Vessel operations	Accidental Release - LOC - Vessel Collision	Change in water quality	**Further assessment required (Section 5.4).**									

4.3 Risk: Introduction of Invasive Marine Species

4.3.1 Cause of aspect

Vessels ballast water exchange and vessel and sub-sea equipment biofouling.

4.3.2 Potential Impact

Discharge of ballast water and biofouling has the potential to introduce Invasive Marine Species (IMS).

IMS are marine plants or animals that have been introduced into a region beyond their natural range and can survive, reproduce and establish founder populations.

The New Zealand screw shell (*Maoricolpus roseus*), which is classed as a marine pest, is known to occur within the Bass Strait and has been identified within each asset's Operational Area.

During vessel activities the vessel may move between each asset's Operational Area and potentially other Cooper Energy assets. In-water equipment that may be redeployed at another location (ROV, sample equipment) has the potential to spread IMS if fouled. To reduce this risk any in-water equipment deployed will be cleaned prior to leaving the asset's Operational Area to reduce risks of translocation.

4.3.2.1 Change in ecosystem dynamics

IMS have the potential to change ecosystem dynamics by competing for natural resources, reducing the availability of natural resources, predation, changing natural cycling processes, segregation of habitat, spread of viruses, changing water quality, producing toxic chemicals, disturbing, injuring or killing vital ecosystem organisms (ecosystem engineers and keystone species), changing surrounding ecosystems, changing conservation values of protected areas and creating new habitats.

4.3.2.2 Changes in the functions, interests or activities of other users

IMS have proven economically damaging to areas where they have been introduced and established, particularly as IMS are difficult to eradicate from areas once established (Hewitt et al. 2002). If the introduction is captured early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life. It has been found that highly disturbed nearshore 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).

4.3.3 Consequence Evaluation

In Commonwealth waters, successful colonisation in the recipient region would be less likely given that the benthic habitats within and near the Operational Area are predominantly bare sands with patchy occurrences of hard substrate and are within deeper waters (i.e. approximately 125 m) which are unlikely to support benthic communities.

In State waters, successful colonisation of IMS may occur on hard substrates or artificial structures.

If an IMS was introduced, and if it did colonise an area, there is the potential for impacts to marine communities which support listed marine fish species and commercial fish and invertebrate

species. No protected marine areas, habitats or communities were identified in or near the Operational Area that may be impacted.

Consequently, if an IMS is introduced there is the potential for localised medium-term impacts to benthic communities which support listed marine fish species and commercial fish and invertebrate species resulting in a **Moderate (3)** consequence.

4.3.4 Control Measures, ALARP and Acceptability Assessment

Table 4-6 provides a summary of the control measures and ALARP and Acceptability Assessment for the risk of introducing invasive marine species.

Table 4-6: Ballast Water and Biofouling ALARP, Control Measures and Acceptability Assessment

ALARP Decision Context and Justification	**ALARP Decision Context: B**
Summary of Control Measures	
C15: Marine Order 98: Marine pollution – anti-fouling systems C16: National Biofouling Management Guidance for the Petroleum Production and Exploration Industry C17: Australian Ballast Water Management Requirements C18: Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Biofouling Guidelines)	
Likelihood	**Unlikely (D)**
Residual Risk	**Medium**

4.4 Risk: Loss of Containment

4.4.1 Cause of aspect

A number of loss of containment scenarios where identified that required further assessment. Accidental releases that could occur at Sole, PB and BMG are identified in Table 4-7.

Table 4-7: Potential Loss of Containment Release Types, Causes and Estimated Volumes

Accidental Release Types	Cause of Aspect	Fluid Type and Volume
Loss of containment: PB pipeline	Loss of containment from the PB pipeline as a result of erosion, corrosion or external forces (e.g. fishing vessel interactions or dropped object).	Gas: 2,700 m^3 Nitrogen: 4,550 m^3 Longtom condensate: 5 m^3 MEG/water mix (40:60 ratio): 150 m^3

Accidental Release Types	Cause of Aspect	Fluid Type and Volume
Loss of containment: PB umbilical	Loss of containment from an umbilical as a result of third party damage.	Hydraulic fluid: 3.2 m^3
Loss of well control: PB	Patricia-2 and Baleen-4: The Patricia-2 and Baleen-4 wells were leak-tested prior to being shut in with two tested barriers which met the requirements of API 14B. A significant well release is not deemed credible from these well on this basis. The Patricia and Baleen fields are significantly depleted and consist of dry gas. A pressure-volume-temperature (PVT) analysis (Santos, 2014) was undertaken for the Patricia and Baleen field and found that if the well did flow there would be no condensate recovery from the gas. Patricia-1 well has been suspended to industry standards.	Dry gas: 0.022 MMscfd (900 scf/hr)
Loss of containment: Sole pipeline	Loss of containment from the Sole pipeline as a result of erosion, corrosion or external forces (e.g. fishing vessel interactions or dropped object). Volumes assumed base rate of 67.5 MMscfd during operations.	Gas: 274,000 m^3 Condensate: 1 m^3 MEG: 5.3 m^3 Corrosion inhibitor: 4 L
Loss of containment: Sole umbilical	Loss of containment from an umbilical as a result of third party damage.	MEG: 61.4 m^3 Hydraulic fluid HP: 41.0 m^3 Corrosion inhibitor: 9.0.5m^3 Hydraulic fluid LP: 17.7 m^3
Loss of well control: Sole	Loss of well integrity or third party damage leading to LOWC. Volume assumes well head has been completely removed and LOC is via open hole through the production tubing at the seafloor. This is not a credible scenario but has been used as a conservative approach for the operating wells. Sole-2 well has been suspended to industry standards.	Max gas: 149 MMscfd at seafloor
Loss of containment: BMG flowlines	A loss of containment from the flowlines as a result of third party impact, dropped object damage or internal/external corrosion. Along with inhibited water some residual gas maybe present in these structures and the Basker-6 flowline contains ~ 2.3 m^3 diesel from previous dewaxing activities.	Max initial gas: 460 kg Longer term gas: 2 kg/day Diesel: 2.3 m^3 Inhibited water: 101.07 m^3
Loss of containment:	A loss of containment from the manifold or jumpers as a result of third party impact, dropped object	Max initial gas: 230 kg

Accidental Release Types	Cause of Aspect	Fluid Type and Volume
BMG manifold and jumpers	damage or internal/external corrosion. Maximum credible value of initial release is 230 kg/day gas, with likely figure considerably less. A special case is the B6 flowline where initial volume is estimated at 70kg. Low levels of condensate to accompany this release rate. Max long-term release likely estimated at under 20 kg/day (jumper volume)	Longer term gas: 20 kg/day Diesel: 2.3 m^3 Inhibited water: 101.07 m^3
Loss of containment: BMG umbilical	Loss of containment from an umbilical as a result of third party damage.	Hydraulic fluid: 4,201 L Gas: 1 – 2 kg/day
Loss of well control: BMG	BMG wells designed and tested to API 6A and pressure tested on completion have been shut-in with at least two independent mechanical barriers confirmed and tested on the tubing side with one downhole barrier (i.e. between the reservoir and the environment). Where the barrier contained a valve, it was tested in accordance with API 14B[1]. For wells which did not meet this requirement (Basker-5) the reservoir section of the well was abandoned and tested in accordance with the requirements for a permanent barrier. All subsurface safety valves and valves on the wellheads were verified as closed. The NPP risk assessment (NPP Risk Assessment 3826-HS-H0106) looked at credible failure mechanisms and determined the incidents which might result in a hydrocarbon release from production wells. These largest of these was conservatively assessed as: Third party impact damage to the wellhead with a maximum rate of 0.022 MMscfd (650kg/d) gas, negligible oil and approximately 0.75 bbl/d[2] (120 kg/day) condensate may be expected to be released to the environment for a 20 day period. A longer term continuous leak would be up to 130 kg/day with small amounts of condensate, but more likely 0 – 5 kg/day gas. Negligible hydrocarbon liquids (i.e. BMG crude) released.	Initial released 20 days: Gas: 0.022 MMscfd (650 kg/day) Condensate: 0.75 bbl (120 L/day) Longer term: Gas: 130 kg/day Condensate: minor
Vessel collision	A collision between the survey vessel and a third-party vessel could result in a tank rupture.	MDO: 250 m^3

[1] It should be noted that this criteria establishes if valves leak in excess of 900 scf/hr (gas) or 24 ltrs/hr (liquid) (i.e. it is not a leak-tight test). Therefore, over time leakage past valves may lead to some re-pressurisation of subsea equipment. This equipment is ultimately enclosed by a “leak tight” blind flange at the end of flowlines.

[2] This release rate does not create a visible sheen at the sea surface (RPS-APASA, 2012).

Accidental Release Types	Cause of Aspect	Fluid Type and Volume
	For the impact assessment the vessel largest fuel tank volume was used as recommended by AMSA's guideline for indicative maximum credible spill volumes for other, non-oil tanker, vessel collision (AMSA 2015). This was assessed to be 250 m^3 of marine diesel oil (MDO). Vessel grounding was not assessed as a credible risk as the closest distance to shore that a vessel would operate would be at the PB or Sole HDD sites which are ~ 300 m from shore and in waters depths of > 9 m. There are no emergent features within the Operational Area.	

4.4.2 Potential Impact

Spills to the marine environment have the potential to expose ecological and social receptors to different hydrocarbon expressions and concentrations. Hydrocarbon expressions include:

- Surface; and
- In water (entrained only).

These exposures have the potential to result in potential impacts directly via:

- Potential toxicity effects/physical oiling
- Potential for reduction in intrinsic values/visual aesthetics.

Or indirectly as a result of the potential impacts noted above, there is the potential to result in

- Potential impact to commercial businesses.

Each of the release types identified in Table 4-7 are further discussed to identify potential impacts.

4.4.3 Consequence Evaluation

The likely consequence from each spill fluid type is assessed in the following tables:

- Chemicals – Table 4-8
- Gas – Table 4-9
- MDO surface - Table 4-10
- MDO in water - Table 4-12

A vessel diesel spill covers the largest area. No exposure above the dissolved aromatic threshold was predicted at either depth level, therefore the evaluation in Table 4-12 is on entrained aromatics only.

No Australian Marine Parks were predicted to be exposed to oil above the EMBA thresholds. However, it was identified that the East Gippsland Marine Park is outside the EMBA and may be impacted by threshold levels below those used to define the EMBA.

Table 4-8: Consequence Evaluation for Chemicals – In-water

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Ecological Receptors	Marine Fauna	Plankton	Chemicals such as MEG and Transaqua HT2™ contain PLONOR substances, are biodegradable and are not expected to bio-accumulate. Corrosion inhibitors are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process (e.g. reaction with available oxygen), ensuring there is little or no residual chemical concentration remaining upon discharge. Biocides toxicity reduces overtime, they are highly biodegradable and do not bioaccumulate. It is expected that any inhibited water released with biocide will be rapidly dispersed and mix with receiving waters to levels below NOECs.	Due to the dynamic wind and current conditions in the Bass Strait, spilt chemicals would disperse rapidly and mix with the receiving waters. The potential consequence to social and ecological receptors is considered to be **Negligible (1)**, as impacts to water quality are expected to be temporary and localised and therefore will not impact on plankton, marine fauna and commercial fish species that maybe transient within the Operational Area or affect local ecosystem functioning or the values and functions of the KEF. No significant impacts to third parties are predicted.
		Marine Invertebrates		
		Marine Reptiles		
		Fish and Sharks		
		Pinnipeds		
		Cetaceans		
Social Receptors	Human System	Commercial Fisheries		
		Upwelling East of Eden KEF		

Table 4-9 Consequence Evaluation for Gas Exposure – In-water

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Ecological Receptors	Marine Fauna	Plankton	Gas released at the seabed will rapidly dissipate through the water column with only temporary and minor water quality reduction.	Low-oxygen conditions caused by methane-consuming microbes, could threaten small marine organisms (e.g. plankton,
		Marine Invertebrates		

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Marine Reptiles	The rapid rise of gas to surface in a LOWC event will release gas to the atmosphere rather than being trapped at depth in the water column. A small portion may remain in the waters occupied by and surrounding the gas plume, but this would not be expected to result in significant oxygen depletion given surrounding waters are generally well mixed.	fish larvae, and other fauna that are not actively mobile, that provide a vital link in the marine food chain. However, given the relatively shallow and well mixed surrounding waters, this is not considered likely to occur. Toxicity impacts are not predicted so the potential consequence to social and ecological receptors is considered to be **Negligible (1)**, as impacts are expected to be temporary and localised and therefore will not impact on plankton, marine fauna and commercial fish species that maybe transient within the Operational Area or affect local ecosystem functioning or the values and functions of the KEF. No significant impacts to third parties are predicted.
		Fish and Sharks		
		Pinnipeds		
		Cetaceans		
Social Receptors	Human System	Commercial Fisheries		
		Upwelling East of Eden KEF		

Table 4-10 Consequence evaluation for MDO hydrocarbon exposure – Surface

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Ecological Receptors	Marine Fauna	Seabirds	Several threatened, migratory and/or listed marine species have the potential to be rafting, resting, diving and feeding within the area predicted to be contacted by >10 g/m^2 surface hydrocarbons. There are several foraging BIAs that are present within the area potentially exposed to >10 g/m^2 surface hydrocarbons for albatross, petrel, and shearwater species. Foraging BIAs are typically large broad areas (e.g. Antipodean Albatross) (Section 3.10 - Addendum	When first released, MDO 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 may be impacted, however, it is unlikely that a large number of birds will be affected as sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with areas where hydrocarbons concentrations greater than 10 µm and due to physical oiling

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
			1). The birds can feed via surface skimming or diving – both exposing the bird to any oil on the water surface. No breeding activity occurs in oceanic waters.	may experience lethal surface thresholds. As such, acute or chronic toxicity impacts (death or long-term poor health) to birds are possible but unlikely for an MDO spill as the number of birds would be limited due to the small area and brief period of exposure above 10 µm (exposures expected to reduce < 10 µm within 36 hours). Therefore, potential impact would be limited to individuals, with population impacts not anticipated. The potential consequence to seabirds from a vessel collision (MDO) event is assessed as **Minor (2)** based on the potential for localised and short-term impacts to species of recognized conservation value but not affecting local ecosystem functioning.
		Marine Turtles	There may be marine turtles in the area predicted to be >10 g/m^2. However, there are no BIAs or habitat critical to the survival of the species within this area.	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 MDO is expected to be low as there are no BIAs or habitat critical to the survival of the species present, hence, turtles may be transient within the EMBA. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
				The potential consequence to turtles from a vessel collision (MDO) event is assessed as **Minor (2)** based on the potential for localised and short-term impacts to species of recognized conservation value but not affecting local ecosystem functioning.
		Marine Mammals (Pinnipeds)	There may be pinnipeds in the area predicted to be affected by hydrocarbons 10 g/m^2. However, there are no BIAs or habitat critical to the survival of the species within this area.	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 pinnipeds that may be exposed to MDO is expected to be low as there are no BIAs or habitat critical to the survival of the species present, hence, pinnipeds may be transient within the EMBA. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would be limited to individuals, with population impacts not anticipated. Given that fur seals are vulnerable to hypothermia from oiling, the potential consequence to pinnipeds from a vessel collision (MDO) event is assessed as **Moderate (3)** based on the potential for medium term impacts to species of recognized conservation value but not affecting local ecosystem functioning.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Marine Mammals (Cetaceans)	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within an area predicted to be above the surface thresholds of >10 g/m^2. Known BIAs are present for foraging for Pygmy Blue Whales; distribution for Southern Right Whales and migration for Humpback Whales within the EMBA.	Physical contact by individual whales of MDO is unlikely to lead to any long-term impacts. Given the mobility of whales, only a small proportion of the migrating population would surface in the affected areas, resulting in short-term and localised consequences, with no long-term population viability effects. 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 >10 g/m^2 (10 µm), however due to the short duration of the surface exposure above the impact threshold (~36 hrs), this is not likely. The potential consequence to cetaceans from a vessel collision (MDO) event is assessed as **Minor (2)** based on the potential for localised and short-term impacts to species of recognized conservation value but not affecting local ecosystem functioning.
Social Receptors	Natural Systems	Key Ecological Features	Big Horseshoe Canyon and Upwelling East of Eden are within the area predicted to be above the surface thresholds of >10 g/m^2. Values associated with these areas are: • Big Horseshoe Canyon – hard substrate for benthic flora and fauna. As surface hydrocarbons would not impact on these values no further evaluation is required. • Upwelling East of Eden – high productivity and aggregations of whales, seals, sharks and seabirds.	Based on the worse case potential consequence to key receptors within the Upwelling East of Eden KEF (e.g. seabirds, pinnipeds and cetaceans), the potential consequence to this KEF is assessed to be **Moderate (3)** as per the assessment for pinnipeds. Refer also to: • Seabirds. • Marine mammals (Pinnipeds, Cetaceans).

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Social Receptors	Natural Systems	State Marine Protected Areas	Beware Reef Marine Sanctuary and Point Hicks Marine Park are within the area predicted to be above the surface threshold of >10 g/m^2. Values associated with these areas include providing habitats for a diverse range of invertebrates, fish, mammals and birds.	Based on the worse case potential consequence to key receptors (e.g. seabirds, pinnipeds and cetaceans) the potential consequence to this KEF is assessed to be **Moderate (3)** as per the assessment for pinnipeds. Refer also to: • Seabirds. • Marine mammals (Pinnipeds, Cetaceans).
	Human Systems	Recreation and Tourism (including recreational fisheries)	Marine pollution can result in impacts to marine-based tourism from reduced visual aesthetic. MDO is known to rapidly spread and thin out on release and consequently, a large area may be exposed to hydrocarbon concentrations greater than1 g/m^2. Based upon a large release of diesel within the Sole Field, concentrations greater than 1 g/m^2 can be expected to be visible over 52 km from the release location.	Visible surface hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. Given the nature of the oil, it is expected to rapidly weather offshore and once onshore is expected to continue weathering until it is flushed via natural processes from the coastline, or until it is physically cleaned-up. Regardless any exposure is expected to be limited in duration and consequently, the potential consequence to recreation and tourism from a vessel collision (MDO) event are considered to be **Minor (2)** as they could be expected to result in localised short-term impacts. Refer also to: • Marine Mammals (Pinnipeds, Cetaceans). • State Marine Protected Areas.
		Shipping	Shipping occurs within the area predicted to be above the surface threshold of >10 g/m^2.	Vessels may be present in the area where sea surface oil is >10 g/m^2 (10 µm), however, due to the short duration of the surface exposure above the impact threshold (~36 hrs) impacts would be localised and short term, consequently, the potential consequence is considered to be **Negligible (1).**

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Oil and gas	Oil and gas platforms are located within the area predicted to be above the surface threshold of >10 g/m^2.	Oil and gas infrastructure present in the area where sea surface oil is >10 g/m^2 (10 µm) could be potentially oiled. However, due to the short duration of the surface exposure above the impact threshold (~36 hrs) impacts would be localised and short term, consequently, the potential consequence is considered to be **Negligible (1).**

Table 4-11 Consequence evaluation for MDO hydrocarbon exposure – Shoreline

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Ecological Receptors	Habitat	Rocky Shoreline	Rocky shores are predicted to be within the area potentially exposed to hydrocarbons ashore; however, within the stretch of coast where shoreline contact could be expected, there is no sheltered rocky coasts (i.e. those rocky coasts more sensitive to shoreline oiling). As MDO is not sticky or viscous, if it contacts rocky shorelines, it is not expected to stick with tidal washing expected to influence the longevity of exposure.	The sensitivity of a rocky shoreline to oiling is dependent on a number of factors including its topography and composition, position, exposure to oceanic waves and currents etc. Exposed rocky shorelines are less sensitive than sheltered rocky shorelines. One of the main identified values of rocky shores/scarps is as habitat for invertebrates (e.g. sea anemones, sponges, sea-squirts, molluscs). Rocky areas are also utilised by some pinniped and bird species; noting that foraging and breeding/nesting typically occurs above high tide line. The impact of oil on any organism depends on the toxicity, viscosity and amount of oil, on the sensitivity of the organism and the length of time it is in contact with the oil. Even where the immediate damage to rocky shores from oil spills has been considerable, it is unusual for this to result in long-term

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
				damage and the communities have often recovered within 2 or 3 years (IPIECA, 1995). The potential consequence to rocky sites from a vessel collision (MDO) event is assessed as **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function. Refer also to: • Marine Invertebrates. • Seabirds and Shorebirds. • Pinnipeds.
		Sandy Shoreline	Sandy beaches are predicted to be within the area potentially exposed to hydrocarbons ashore. Sandy beaches are the predominant habitat type within the stretch of coast where shoreline contact could be expected from a vessel collision (MDO) event. MDO would be expected to penetrate porous sediments of sandy shorelines quickly but may also be washed off shorelines just as quick via waves and tidal flushing. NOAA (2014) note that as MDO is readily and completely degraded by naturally occurring microbes, it could be expected to disappear from shorelines within one to two months. MDO has the potential to be buried due to the continual washing in the intertidal zone.	Sandy beaches are considered to have a low sensitivity to hydrocarbon exposure. Sandy beaches provide habitat for a diverse assemblage (although not always abundant) of infauna (including nematodes, copepods and polychaetes); and macroinvertebrates (e.g. crustaceans). Due to proximity to shore, a release of MDO may reach the shoreline prior to it completely weathering and consequently impacts due to toxicity and/or smothering of infauna may occur. The potential consequence to sandy shorelines from a vessel collision (MDO) event is assessed as **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
				Refer also to: • Marine Invertebrates. • Seabirds and Shorebirds. • Pinnipeds. • Recreation.
		Mangroves	Strands of mangroves are predicted to be within the area potentially exposed to hydrocarbons ashore, however, within the stretch of coast expected to be exposed from vessel collision (MDO) event, there is no coastal habitat mapped specifically as this vegetation type. Oil can enter mangrove forests when the tide is high and be deposited on the aerial roots and sediment surface as the tide recedes. This process commonly leads to a patchy distribution of the oil and its effects, because different places within the forests are at different tidal heights (IPIECA 1993, NOAA 2014). The physical smothering of aerial roots by standard hydrocarbons can block the trees' breathing pores used for oxygen intake and result in the asphyxiation of sub-surface roots (International Petroleum Industry Environmental Conservation Association (IPIECA 1993).	Mangroves are considered to have a high sensitivity to hydrocarbon exposure. Mangroves can be killed by heavy or viscous oil, or emulsification, that covers the trees' breathing pores thereby asphyxiating the subsurface roots, which depend on the pores for oxygen (IPIECA 1993). Mangroves can also take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop et al. 1987). Acute impacts to mangroves can be observed within weeks of exposure, whereas chronic impacts may take months to years to detect. Given the non-viscous nature of MDO and impacts are expected to be limited to the volatile component of the hydrocarbon, however given their sensitivity to hydrocarbons, the potential consequence to mangroves is assessed to be **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.
		Saltmarsh	Communities of saltmarsh are predicted to be within the area potentially exposed to hydrocarbons ashore; and is present within some estuaries and inlet/riverine systems. Some of the	Saltmarsh is considered to have a high sensitivity to hydrocarbon exposure. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
			saltmarsh habitat along this coast will be representative of the Subtropical and Temperate Saltmarsh TEC. Oil can enter saltmarsh systems during the tidal cycles, if the estuary/inlet is open to the ocean. Similar to mangroves, this can lead to a patchy distribution of the oil and its effects, because different places within the inlets are at different tidal heights. Oil (in liquid form) will readily adhere to the marshes, coating the stems from tidal height to sediment surface. Heavy oil coating will be restricted to the outer fringe of thick vegetation, although lighter oils can penetrate deeper, to the limit of tidal influence.	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). The potential consequence to saltmarsh is assessed to be **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.
	Marine Fauna	Invertebrates	Invertebrates that live in intertidal zones include crustaceans, molluscs and infauna, and can be present in wide range of habitats including sandy beaches and rocky shores (refer also to the exposure evaluation for these habitats). Exposure to hydrocarbons for invertebrates is typically via direct contact and smothering but can also occur via ingestion.	The impact of oil on any marine organism depends on the toxicity, viscosity and amount of oil, on the sensitivity of the organism and the length of time it is in contact with the oil. Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological impacts, reproductive impacts, smothering and potentially cause death. However, the presence of an exoskeleton (e.g. crustaceans) will reduce the impact of hydrocarbon absorption through the surface membrane. Other invertebrates with no exoskeleton and larval forms may be more sensitive to impacts from hydrocarbons. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, but can eventually be lost. As MDO is expected to rapidly spread out, a large portion of the coast with the potential to be exposure to hydrocarbons

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
				comprises habitats that are suitable for intertidal invertebrates could be exposed, with the potential consequences assessed as **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.
		Seabirds and Shorebirds	Listed marine, threatened and/or migratory bird species have the potential to be resting, feeding or nesting within the area potentially exposed to hydrocarbons ashore. This fauna can be present in wide range of habitats including sandy beaches and rocky shores (refer also to the exposure evaluation for these habitats). There are several foraging BIAs throughout the area, however these species are oceanic foragers, not shoreline foragers. Shorebirds will still utilise intertidal and onshore zones for feeding though no BIAs or habitat critical to the survival of the species have been identified. Given hydrocarbons may wash ashore prior to weathering, there is the potential for both physical oiling and toxicity (e.g. surface contact or ingestion; particularly for shorebirds utilizing the intertidal area. Noting that these events will be temporary, so length of exposure is limited.	Direct contact with hydrocarbons can foul feathers, which may result in hypothermia due to a reduction in the ability of the bird to thermo-regulate and impair water-proofing. Oiling of birds can also suffer from damage to external tissues, including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. Toxic effects may result where the oil is ingested as the bird attempts to preen its feathers, or via consumption of oil-affected prey. The potential consequence to seabirds and shorebirds from a vessel collision (MDO) event is assessed as **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.
		Marine Reptiles	Turtles nesting on exposed shores would be exposed by direct contact with skin/body. However, there are no BIAs or habitat critical to the survival of the species within the shorelines that could be potentially affected. Therefore, shoreline exposure to marine turtles is not expected and not evaluated further.	NA

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Marine Mammals (Pinnipeds)	Listed marine and/or threatened pinniped species have the potential to present within the area predicted to be exposed to hydrocarbons ashore including Beware Reef Marine Sanctuary which is a haul out site for Australian and New Zealand fur seals. There are no BIAs or habitat critical to the survival of the species within the area that maybe exposed to hydrocarbons ashore. Pinnipeds hauling out on exposed shores could be exposed by direct contact of oil with skin/body. Direct oiling is possible but expected to have a limited window for occurring due to rapid weathering and flushing of MDO.	Pinnipeds have high site fidelity and can be less likely to exhibit avoidance behaviours, thus staying near established colonies and haul-out areas. Fur seals are particularly vulnerable to hypothermia from oiling of their fur and consequently, once onshore hydrocarbons pose a significant hazard to pinnipeds with biological impacts caused from ingestion possibly resulting in reduced reproduction levels. Thus, the potential consequence to pinnipeds from exposure are assessed as **Moderate (3)** based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.
Social Receptors	Natural System	Wetlands	Wetlands are predicted to be within the area potentially exposed to hydrocarbons ashore, however, no nationally or internationally important wetlands are present in this area.	The impacts of hydrocarbons on wetlands are generally similar to those described for mangroves and saltmarshes. The degree of impact of oil on wetland vegetation are variable and complex, and can be both acute and chronic, ranging from short-term disruption of plant functioning to mortality. Spills reaching wetlands during the growing season will have a more severe impact than if oil reaches wetlands during the times when many plant species are dormant. Wetland habitat can be of particular importance for some species of birds and invertebrates. As such, in addition to direct impacts on plants, oil that reaches wetlands also affects these fauna utilising wetlands during their life cycle, especially benthic organisms that reside in the sediments and are a foundation of the food chain. Thus, the potential consequence to wetlands from exposure are assessed as **Moderate (3)** based on the potential for

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
				localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function. Refer also to: • Marine Invertebrates. • Seabirds and Shorebirds.
	Human System	Coastal Settlements	Coastal settlements are within the area potentially exposed to hydrocarbons ashore; however, the stretch of coast expected to be exposed is not densely populated. Noting that these events will be temporary, so duration of exposure is also limited. Most of the hydrocarbons will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible.	Visible hydrocarbons have the potential to reduce the visual amenity of the area for coastal settlements. Given its rapid weathering and potential for tidal flushing and rapid degradation, the potential consequence to coastal settlements is assessed as **Minor (2)** based on the potential for localised short-term impacts. Refer also to: • Rocky Shores. • Sandy Beaches.
		Recreation and Tourism	Recreational and tourism activities occur within the area potentially exposed hydrocarbons ashore; however, the stretch of coast expected to be exposed, as such the volume of recreation/tourism is not as high as other places. Noting that these events will be temporary, so duration of exposure is also limited. Most of the oil will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible.	Visible hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The potential consequence to recreation and tourism is assessed as **Minor (2)** based on the potential for localised short-term impacts. Refer also to: • Rocky Shores. • Sandy Beaches. • Coastal Settlements.
		Heritage	Specific locations of spiritual and ceremonial places of significance, or cultural artefacts, are often unknown, but are	Visible hydrocarbons have the potential to reduce the visual amenity of heritage sites. However, it is expected that these

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
			expected to be present along the mainland coast. Therefore, there is the potential that some of these sites may be within the area potentially exposed to hydrocarbons ashore. Noting that these events will be temporary, so duration of exposure is also limited. Most of the oil will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible.	sites would be above the high tide mark. Thus, the potential consequence to heritage is assessed as **Minor (2)** as they could be expected to result in localised short-term impacts. Refer to: • Rocky Shores. • Sandy Beaches. • Coastal Settlements.

Table 4-12 Consequence evaluation for MDO hydrocarbon exposure – In-water

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Ecological Receptors	Habitat	Coral	Soft corals may be present within reef and hard substrate areas within the area predicted to be exposed above thresholds. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO residue.	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 hard coral reef formations, and the sporadic cover of soft corals in mixed reef communities, such impacts are considered to be limited to isolated corals. Thus, the potential consequence to corals is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Macroalgae	Macroalgae may be present within reef and hard substrate areas within the area predicted to be exposed above thresholds, however, it is not a dominant habitat feature in eastern Victoria or other regions of the EMBA. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO residue.	Reported toxic responses to oils have included a variety of physiological changes to enzyme systems, photosynthesis, respiration, and nucleic acid synthesis (Lewis & Pryor 2013). A review of field studies conducted after spill events by Connell et al. (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. In the event that a TEC: Giant kelp marine forests of SE Australia is present within the area potentially affected following a spill, there is the potential to expose this important habitat to in-water hydrocarbons. However as described above, given hydrocarbons are expected to have limited impacts to macroalgae and as MDO is not sticky and expected to rapidly degrade upon release, the potential consequence to macroalgae is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.
		Seagrass	Seagrasses may be present within the area predicted to be exposed above thresholds. Seagrass in this region isn't considered a significant food source for marine fauna.	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). Thus, the potential consequence to seagrass is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.
		Plankton	Plankton are likely to be exposed to entrained above thresholds. Exposure above thresholds is predicted in	Relatively low concentrations of hydrocarbon are toxic to both plankton [including zooplankton and ichthyoplankton (fish eggs

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
	Marine Fauna		the 0-10 m water depth, which is also where plankton are generally more abundant. Entrained phase MDO may intersect the Upwelling East of Eden KEF. While a spill would not affect the upwelling itself, if the spill occurs at the time of an upwelling event, it may result in krill being exposed to low (effects) level entrained phase MDO (99% species protection). Pygmy blue whales feeding on this krill may suffer from reduced prey, however, these impacts are expected to be extremely localised and temporary.	and larvae)]. Plankton risk exposure through ingestion, inhalation and dermal contact. 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 2011f), allowing for seasonal influences on the assemblage characteristics. Thus, the potential consequence to plankton is assessed as **Minor (2)** based on the potential for short-term and localised impacts, but not affecting local ecosystem functioning.
		Invertebrates	The modelling indicates that temporary patches of entrained MDO may be present at 0-10 m water depth. Impact by direct contact of benthic species with hydrocarbon in the deeper areas of the release area is not expected given the surface nature of the spill and the water depths throughout much of the EMBA. Species closer to shore may be affected although these effects will be localised, low level and temporary, noting that in-water thresholds selected for interpretation are effects levels for 95-99% species protection. Filter-feeding benthic invertebrates such as sponges, bryozoans, abalone and hydroids may be exposed to sub-lethal impacts, however, population level impacts	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. Thus, the potential consequence to invertebrates including commercially fished invertebrates is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
			are considered unlikely. Tissue taint may occur and remain for several months in some species (e.g. lobster, abalone) however, this will be localised and low level with recovery expected. In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Several commercial fisheries for marine invertebrates are within the area predicted to be exposed above the impact threshold: • Cth Southern Squid Jig Fishery. • Victorian Abalone Fishery. • Victorian Rock Lobster Fishery. • Victorian Giant Crab Fishery.	
		Fish and Sharks	Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, which modelling does not predict is exposed >10m water depth. Therefore, any impacts are expected to be highly localised. There is a known distribution and foraging BIA for the Great white shark in the area predicted to be over the	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. Impacts on fish 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 areal extent of the spill. 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.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
			impact threshold, however, it is not expected that this species spends a large amount of time close to the surface where thresholds are predicted to be exceeded.	Thus, the potential consequence to fish and sharks including commercially fished species is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.
		Pinnipeds	Localised parts of the foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low concentrations of entrained MDO in the water column (no dissolved phase).	Exposure to low/moderate effects level hydrocarbons in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds, however given the temporary and localised nature of the spill, their widespread nature, the low-level exposure zones and rapid loss of the volatile components of MDO in choppy and windy seas (such as that of the EMBA), the potential consequence is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.
		Cetaceans	Several threatened, migratory and/or listed marine species have the potential to be migrating, resting or foraging within an area predicted to be above the surface thresholds. Known BIAs are present for foraging for the Pygmy Blue Whale; distribution for the Southern Right Whale and migration for the Humpback Whale. 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 would be limited to a relatively short period following the release and would need to coincide with migration to result in exposure to a large number of individuals. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the migrating population of whales could be affected for a single migration event, thus potential consequence is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
Social Receptors Social Receptors	Human System	Commercial Fisheries and Recreational Fishing	In-water exposure to entrained MDO may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the EMBA and overlap the spatial extent of the water column hydrocarbon predictions.	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 MDO would only be in place 1-3 days after release, therefore physical displacement to vessels is unlikely to be a significant impact. Thus, the potential consequence to commercial and recreational fisheries is assessed as **Minor (2)** based on the potential for localised short-term impacts to species/habitats of recognised conservation value, but not affecting local ecosystem functioning. Refer also to: • Fish and Sharks. • Invertebrates.
	Natural System	State Marine Protected Areas	Marine protected areas predicted to be exposed to entrained hydrocarbons above thresholds are Beware Reef Marine Sanctuary and the Point Hicks Marine National Park. Conservation values for these areas include high marine fauna and flora diversity, including fish and invertebrate assemblages and benthic coverage (sponges, soft corals, macroalgae). Beware Reef is also haul-out sites for pinnipeds.	Based on the worse case potential consequence to key receptors the consequence to protected marine areas is assessed **Minor (2).** Refer to: • Invertebrates. • Macroalgae. • Pinnipeds.

Environment	Receptor Group	Receptor Type	Exposure Evaluation	Consequence Evaluation
		Key Ecological Features	Big Horseshoe Canyon and Upwelling East of Eden are predicted to be exposed to entrained hydrocarbons above thresholds. Values associated with these areas are: • Big Horseshoe Canyon – hard substrate for benthic flora and fauna. • Upwelling East of Eden – high productivity and aggregations of whales, seals, sharks and seabirds.	Based on the worse case potential consequence to key receptors within these KEFs, the potential consequence is assessed to be **Minor (2)**. Refer also to: • Coral. • Macroalgae. • Seagrass. • Plankton. • Invertebrates • Seabirds. • Fish and Sharks. • Marine mammals (Pinnipeds, Cetaceans).

4.4.4 Control Measures, ALARP and Acceptability Assessment

Table 4-13 provides a summary of the control measures and ALARP and Acceptability Assessment for the risk of loss of containment.

Table 4-13: Loss of Containment ALARP, Control Measures and Acceptability Assessment

ALARP Decision Context and Justification	**ALARP Decision Context: B**
Summary of Control Measures	
C19: Petroleum Safety Zone C20: Subsea infrastructure identified to marine users C21: Accepted Safety Case C22: Accepted WOMP C23: Marine Order 3: Seagoing qualifications C24: Marine Order 30: Prevention of collisions C25: Marine Order 31: Vessel surveys and certification C14: SMPEP (or equivalent) C11: Ongoing consultation C26: Fisheries Damage Protocol	
Likelihood	**Remote (E)**
Residual Risk	**Low**

5 Oil Spill Response Overview

5.1 Oil Spill Response Strategies

This section presents the risk assessment for oil spill response options as required by the OPGGS(E) Regulations (Cwlth) and OPGGS Regulation (Vic) 15(4)(b). This section informs the Cooper Energy Victorian OPEP (VIC-EPER-EMP-0001).

5.1.1 Hydrocarbon Spill Risks associated with the Activity

Table 5-1 summarises the spill scenarios for the PB, Sole and BMG locations during the activities associated with this EP. Where spill scenarios are identified, the control agency is shown in brackets.

Table 5-1: Hydrocarbon spill risks associated with the activity

Spill Risk	State Waters		Commonwealth waters		
	PaB	Sole	PaB	Sole	BMG
Minor vessel spills (Level 1)	✓ (DEDJTR EMD)	✓ (DEDJTR EMD)	✓ (AMSA)	✓ (AMSA)	✓ (AMSA)
LOC Vessel Collision (MDO spill) (Level 1 or 2)	✓ (DEDJTR EMD)	✓ (DEDJTR EMD)	✓ (AMSA)	✓ (AMSA)	✓ (AMSA)
Umbilical, pipeline or infrastructure leak (Chemical, condensate, diesel) (Level 1)	✓ (Cooper Energy)	✓ (Cooper Energy)	✓ (Cooper Energy)	✓ (Cooper Energy)	✓ (Cooper Energy)
LOWC (gas) (Level 1)	-	-	✓ (Cooper Energy)	✓ (Cooper Energy)	✓ (Cooper Energy)

5.1.2 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. By conducting a Net Benefit Assessment Analysis (NEBA) of the available oil spill response options, their suitability to the potential spill scenarios and their recommended adoption for the identified events, appropriate response strategies have been identified and are detailed in Table 5-2.

Table 5-2: Suitability of Response Options

Response Option	Description	LOC – Vessel Collision (MDO)	Viable Response?	Strategic Net Benefit?	BMG Condensate	Viable Response?	Strategic Net Benefit?	LOWC - Gas	Viable Response?	Strategic Net Benefit?
Source Control	Limit flow of hydrocarbons to environment.	Achieved by vessel SMPEP/SOPEP.	✓	✓	Implement offshore inspection to assess and determine remedial option.	✓	✓	Implement Victorian Offshore Source Control Plan (VIC-DC-ERP-0001) to assess and determine remedial option.	✓	✓
Monitor & Evaluate	Direct observation – Aerial or marine; Vector Calculations; Oil Spill Trajectory Modelling; Satellite Tracking Buoys. To maintain situational awareness, all monitor and evaluate options suitable.	MDO spreads rapidly to thin layers. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance is limited in effectiveness in determining spread of oil. Manual calculation based upon weather conditions will be used at the time to provide guidance to aerial observations. Oil Spill Trajectory Modelling may also be used to forecast impact areas. Deployment of oil spill monitoring buoys at the time of vessel incident will assist in understanding the local current regime during the spill event.	✓	✓	Small spill size and rapid weathering. Spill residues at maximum rates are not expected to be visible based upon preliminary modelling performed by RPS-APASA (2012). Leak most likely observed during inspection activities. If identified at surface, monitoring will be used to confirm weathering predictions. Aerial surveillance is considered more effective than vessel surveillance to inform spill response. Vessel surveillance limited in effectiveness in determining spread of oil. Manual calculation based upon weather conditions will be used at the time to provide guidance to aerial observations. Oil Spill trajectory modelling considered limited in ability to predict movement given the size of the spill and resolution of the modelling (unlikely to be used).	✓	✓	For a continuous significant spill event (LOWC) hydrocarbons will be present at the surface for the duration of the release. To maintain situational awareness, all monitor and evaluate techniques will be considered during gas spill incidents to validate predicted impacts and assess the application of further response strategies if required.	✓	✓
Dispersant Application	Breakdown surface spill & draw droplets into upper layers of water column. Increases biodegradation and weathering and provides benefit to sea-surface air breathing animals.	MDO, while having a small persistent fraction, spreads rapidly to thin layers. Insufficient time to respond while suitable surface thicknesses are present. Dispersant application can result in punch-through where dispersant passes into the water column without breaking oil layer down if surface layers are too thin. Application can contribute to water quality degradation through chemical application without removing surface oil. Considered not to add sufficient benefits.	✖	✖	Condensate slick is not expected to be visible. If seen, thickness would not support dispersant application.	✖	✖	The area affected by a LOWC gas release is likely to be localised around the wellhead, with plumes predicted to surface anywhere inside a 50 m radius of the release point.	✖	✖
Contain & Recover	Booms and skimmers to contain surface oil where there is a potential threat to environmental sensitivities.	MDO spreads rapidly to less than 10 µm and suitable thicknesses for recovery are only present for the first 36 hours for a large offshore spill, and there is insufficient mobilisation time to capture residues. In general, this method only recovers approximately 10-15% of total spill residue, creates significant levels of waste, requires	✖	✖	Condensate slick is not expected to be visible. If seen, thickness would not support contain and recovery techniques.	✖	✖	Any gas plume is predicted within 50 m of the release point only with surface exposure above impact/actionable thresholds not expected.	✖	✖

Response Option	Description	LOC – Vessel Collision (MDO)	Viable Response?	Strategic Net Benefit?	BMG Condensate	Viable Response?	Strategic Net Benefit?	LOWC - Gas	Viable Response?	Strategic Net Benefit?
		significant manpower and suitable weather conditions (calm) to be deployed.								
Protect & Deflect	Booms and skimmers deployed to protect environmental sensitivities.	MDO spreads rapidly to less than 10 µm 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 prior to hydrocarbons washing ashore. In addition to this, corralling of surface hydrocarbons close to shore is not expected to be effective for MDO and as thus is not expected to provide sufficient benefit.	✖	✖	Not required. No shoreline impacts predicted	✖	✖	Any gas plume is predicted within 50 m of the release point only with surface exposure above impact/actionable thresholds not expected. No shoreline contact is predicted.	✖	✖
Shoreline Clean-up	Shoreline clean-up is a last response strategy due to the potential environmental impact.	As shoreline exposure is possible depending on the spill location, and as there are various shoreline techniques that are appropriate for this type of hydrocarbon, a shoreline clean-up may be an effective technique for reducing shoreline loadings where access to shorelines is possible.	✓	✓	Not required. No shoreline impacts predicted	✖	✖	Any gas plume is predicted within 50 m of the release point only with surface exposure above impact/actionable thresholds not expected. No shoreline contact is predicted.	✖	✖
Oiled wildlife Response (OWR)	Consists of capture, cleaning and rehabilitation of oiled wildlife. May include hazing or pre-spill captive management. In Victoria, this is managed by DELWP.	Given limited size and rapid spreading of the MDO spill, large scale wildlife response is not expected. However, individual birds could become oiled in the vicinity of the spill. OWR is both a viable and prudent response option for this spill type.	✓	✓	Not expected to create a surface sheen. OWR response not considered viable or offering net benefits	✖	✖	Any gas plume is predicted within 50 m of the release point only with surface exposure above impact/actionable thresholds not expected. Limited potential for oiled wildlife.	✖	✖
Scientific Monitoring	Scientific Monitoring is undertaken to understand and quantify the nature of short term and long term environmental impacts and subsequent recovery.	Given the size and rapid dispersion of a MDO spill scientific monitoring would only be implemented to demonstrate to stakeholders that the impacts from the spill were short-term and localised as predicted. Thus, water and sediment sampling could potentially be undertaken.	✓	✓	Given the limited size, rapid evaporation and dispersion of a condensate spill scientific monitoring would only be implemented to demonstrate to stakeholders that the impacts from the spill were short-term and localised as predicted. Thus, water sampling could potentially be undertaken. Sediment sampling not required as no shoreline impacts.	✓	✓	Gas and water sampling initiated for well-related releases to assist in determining the source of the release. Information would assist in the assessment of source control options.	✓	✓

5.2 Response Priority Areas

To support the identification of priority response areas, shoreline sensitivity analysis and mapping was undertaken guided by IPIECA principles and informed by the regional description of the environment and understanding of receptor presence in the region. Coastal landform types, habitats and other receptors within the region have been ranked based upon sensitivity to hydrocarbon exposure in accordance with the criteria in Table 5-3.

Table 5-3: Sensitivity Criteria

Sensitivity	Code	Criteria
Severe Impact	**S1**	Region of known sensitive habitat (mangrove, salt marshes, and sheltered tidal flats) which if impacted may have significant impacts and long recovery periods. Presence of known threatened species feeding, breeding, nesting or congregation areas. Areas of national significance or biological processes for species of national significance (e.g. breeding sites and National and State Parks, Commonwealth Heritage listed areas). Identified marine sanctuary or reserve.
Medium Impact	**S2**	Region of known moderately sensitive habitats (sheltered rocky rubble coasts, exposed tidal flats, gravel beaches, mixed sand and gravel beaches) which have a medium recovery period (~2-5 years). Presence of known threatened species or cultural heritage impacted. Region of significant commercial activity (e.g. fishing, tourism). Places of public interest such as beaches.
Low Impact	**S3**	Region of known low sensitivity habitat (fine grained beaches, exposed wave-cut platform and exposed rocky shores) which have a rapid recovery period (~ year). Minimal impact to marine life, business, public areas or cultural heritage items.

5.2.1 Priority Response Planning Areas and Tactical Response Plans (TRP)

The EMBA is based on hydrocarbon exposures above defined environmental impact thresholds for the maximum credible hydrocarbon spill event that might occur during petroleum activities. Note, an EMBA based on visual impact thresholds is not used for this analysis, as thresholds are below actionable oil concentrations.

Developing detailed response plans for all sensitivities within the EMBA is not practicable; thus, areas of high sensitivity to hydrocarbon spills within the EMBA were prioritised to identify the priority response planning areas. It is estimated that it takes approximately 5 days to develop and ground-truth a tactical response plan and 24-48 hours to mobilise equipment and personnel to site (Table 5-4).

The priority response planning areas identified are detailed in Table 5-5 along with the appropriate TRP. It was identified that Point Hicks and Beware Reef could have oil ashore within 7 days and that these areas do not currently have a TRP. A TRP will be developed for these areas prior to any vessel activities that could result in a spill that would impact these areas.

developed for these areas prior to any vessel activities that could result in a spill that would impact these areas.

Cooper Energy believes that there is sufficient time to develop TRPs for any remaining sensitive areas (i.e. those that have the potential to be exposed greater than 7 days) in the event that a MDO spill from a vessel collision occurs.

Table 5-4: Estimated time for development of a site specific tactical response plan and resource deployment

Task	Estimated Time (days)
OSTM modelling to identify potentially affected areas	1
Drafting of TRP	1
Consultation with relevant people	2
Ground-truthing of TRP (Site Visit)	1
Mobilisation of equipment and resources	1-2
Total	**7 Days**

Table 5-5: Priority Response Planning Areas

Location	Latitude	Longitude	Summary	TRP
Point Hicks	-37.80	149.27	High biological sensitivity	TBD
Tamboon Inlet	-37.78	149.14	High coastal habitat sensitivity High biological sensitivity	Tamboon Inlet
Sydenham Inlet	-37.78	149.02	High coastal habitat sensitivity High biological sensitivity	Sydenham Inlet
Beware Reef	-37.82	148.79	High biological sensitivity	TBD
Yeerung River	-37.79	148.78	High coastal habitat sensitivity High biological sensitivity	Yeerung River
Snowy River	-37.80	148.55	High coastal habitat sensitivity High biological sensitivity	Snowy River
Gippsland Lakes (east)	-37.86	148.09	High coastal habitat sensitivity High biological sensitivity	Lakes Entrance
Gippsland Lakes (west)	-37.89	147.97	High coastal landform sensitivity High coastal habitat sensitivity High biological sensitivity	Lakes Entrance

5.3 Pre-spill Net Environmental Benefits Assessment (NEBA)

Location specific information was used for each of the priority response planning areas to further refine receptor presence, with these receptors ranked based upon the sensitivity criteria identified in Table 5-3. An assessment of the effective spill response strategies and the net benefit they offer, specific to the sensitivities located within each of the priority response planning areas is provided in Table 5-6.

Table 5-6: Sensitivities, Response Option Feasibility and Planning NEBA

Receptor			Priority Response Planning Area							Response Options							
			Pt Hicks	*Tamboon Inlet*	*Sydenham Inlet*	*Beware Reef*	*Yeerung River*	*Snowy River*	*Gippsland Lakes*								
	Sensitivity	Marine	Croajingolong NP	Croajingolong NP	Cape Conran Coastal Park	Beware Reef Marine Sanctuary	Cape Conran Coastal Park	Snowy River National Park	The Lakes National Park	Oil Type	Source Control	Monitor & Evaluate	Dispersant Application	Contain & Recover	Protect & Deflect	Shoreline Clean-up	Oiled Wildlife Response
										MDO	Yes	Yes	No	No	No	Yes	Yes
										Response Option Effective? Condensate	Yes	Yes	No	No	No	No	No
										Gas	Yes	Yes	No	No	No	No	No
Marine Ecology																	
Cetaceans	S1	✓									↑	-			NA	NA	NA
Pinnipeds	S2	✓									↑	-			NA	NA	NA
Turtles	S2	✓									↑	-			NA	NA	NA
Fish & Sharks	S2	✓									↑	-			NA	NA	NA
Seabirds	S1	✓									↑	-			NA	NA	↑
Invertebrates	S3	✓									↑	-			NA	NA	NA
Plankton	S3	✓									↑	-			NA	NA	NA
Coastal Habitats																	
Saltmarsh/Seagrass	S1		✓		✓						↑	-			NA	↑	NA
Kelp Habitats (inter-tidal)	S2					✓					↑	-			NA	NA	NA
Sand Beaches	S3		✓	✓	✓		✓	✓	✓		↑	-			NA	↑	NA
Sub-tidal Reef	S3										↑	-			NA	NA	NA
Inter-tidal Rocky Plat/Headland	S3		✓			✓					↑	-			NA	↑	NA
Wetlands	S1			✓	✓			✓	✓		↑	-			NA	↑	NA
Coastal Ecology																	
Shoreline Birds	S1		✓					✓	✓		↑	-			NA	↑	↑
Pinniped Haul-out Sites	S2		✓			✓					↑	-			NA	NA	↑
Penguin Colonies	S2										↑	-			NA	NA	NA
Socio-economic																	
Tourism	S2		✓		✓	✓	✓	✓	✓		↑	-			NA	↑	NA
Ports, Harbours, Yacht Club	S3		✓						✓		↑	-			NA	↑	NA
Commercial Fishing/ Aquaculture	S2	✓							✓		↑	-			NA	NA	NA
Recreational Fishing/Diving	S3		✓	✓	✓	✓	✓	✓	✓		↑	-			NA	NA	NA
Shipwrecks (submerged)	S3					✓					↑	-			NA	NA	NA
Aboriginal Heritage/Cultural	S2		✓	✓	✓	✓	✓	✓	✓		↑	-			NA	↑	NA

Legend:

Benefits Assessment:	Effectiveness Assessment:
↑ Net Benefit Compared with only Monitor & Evaluate	Yes: Option suitable for oil type, few restrictions in implementing
↓ Net Loss Compared with only Monitor and Evaluate	Possible: Option suitable for oil type, potential limitations on application
- No net benefit or Loss	Not Recommended: Option not suitable for oil type
NA: Option is not applicable to the Receptor	

5.4 Spill Response: Source Control

Well-related source control activities may range from:

- ROV intervention utilising specialist ROV tooling; and/or
- Well capping; and/or
- Relief well installation.

The potential impacts and risks associated with performing these activities is covered under the aspects evaluated in the accepted WOMP and thus are not considered further.

Source control arrangements for LOC from vessel failures includes:

- Closing water tight doors;
- Checking bulkheads;
- Determining whether vessel separation will increase spillage;
- Isolating penetrated tanks; and
- Tank lightering, etc.

Implementation of source control for vessels is detailed within the below documents, and is not discussed further:

- Vessel-specific Shipboard Oil Pollution Emergency Plan (SOPEP/SMPEP);
- Vessel Specific Safety Cases; and
- National Plan for Maritime Environmental Emergencies (NatPlan).

Source controls arrangements for the Sole pipeline includes shutting in the wells and pipeline. The potential impacts and risks associated with this is covered under the aspects evaluated in the accepted WOMP and Safety Case and thus are not considered further.

For all pipeline and infrastructure leaks and vessel inspection and repair program would be implemented. The potential impacts and risks associated with these activities are covered in this EP.

5.5 Spill Response: Monitor and Evaluate

Ongoing monitoring and evaluation of the oil spill is a key strategy and critical for maintaining situational awareness and to complement and support the success of other response activities. In some situations, monitoring and evaluation may be the primary response strategy where the spill volume/risk reduction through dispersion and weathering processes is considered the most appropriate response. Monitor and evaluate will apply to all marine spills. Higher levels of

surveillance such as vessel/aerial surveillance, oil spill trajectory modelling and deployment of satellite tracking drifter buoys will only be undertaken for Level 2/3 spills given the nature and scale of the spill risk.

It is the responsibility of the Control Agency to undertake operational monitoring during the spill event to inform the operational response. Operational monitoring includes the following:

- Aerial observation;
- Vessel observation;
- Computer-based tools:
    - Oil spill trajectory modelling;
    - Vector analysis (manual calculation);
    - Automated Data Inquiry for Oil Spills (ADIOS) (a spill weathering model); and
- Utilisation of satellite tracking drifter buoys.

5.6 Spill Response: Shoreline Assessment and Clean-up

Any shoreline operations will be undertaken in consultation with, and under the control of DEDJTR EMD, the Control Agency for Victoria and the appropriate land managers of the shoreline affected.

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove oil and contaminated debris from the shoreline to reduce ongoing environmental contamination and impact. It may include the following techniques:

- Natural recovery – allowing the shoreline to self-clean (no intervention undertaken);
- Manual collection of oil and debris – the use of people power to collect oil from the shoreline;
- Mechanical collection – use of machinery to collect and remove stranded oil and contaminated material;
- Sorbents – use of sorbent padding to absorb oil;
- Vacuum recovery, flushing, washing – the use of high volumes of low-pressure water, pumping and/or vacuuming to remove floating oil accumulated at the shoreline;
- Sediment reworking – move sediment to the surf to allow oil to be removed from the sediment and move sand by heavy machinery;
- Vegetation cutting – removing oiled vegetation; and
- Cleaning agents – application of chemicals such as dispersants to remove oil.

Shorelines within the EMBA are predominantly sandy beaches with numerous estuaries present along the Victorian Coastline.

Based upon this behaviour, the following methods may have environmental benefit:

- Manual clean-up;
- Closure of estuaries resulting in additional stranding on sandy beach; and
- Mechanical collection – use of machinery to collect and remove stranded oil and contaminated material.

5.7 Spill Response: Oiled Wildlife Response

In the event of a Level 2 MDO spill, the impacts on wildlife are determined by the types of fauna present, the type of oil spilled and the extent of exposure. A review of the species likely to be present within the EMBA identifies marine birds, shorebirds and fur-seals could be affected.

Oiled wildlife response (OWR) consists of a three-tiered approach involving:

- Primary: Situational understanding of the species/populations potentially affected (ground-truth species presence and distribution by foot, boat or aerial observations);
- Secondary: Deterrence or displacement strategies (e.g., hazing by auditory bird scarers, visual flags or balloons, barricade fences; or pre-emptive capture); and
- Tertiary: Recovery, field stabilisation, transport, veterinary examination, triage, stabilisation, cleaning, rehabilitation, release

6 Implementation Strategy

Regulation 14 of the OPGGS(E) Regulations (Cwlth) and Regulation 16 of the OPGGS Regulations (Vic) requires that an implementation strategy must be included in an EP. The implementation strategy described in this section provides a summary of the Cooper Energy Health Safety Environment and Community Management System (HSEC MS).

6.1 Cooper Energy Management System

The HSEC MS is Cooper Energy's corporate system which provides the framework for the delivery of Cooper Energy's values, policies, standards and practices related to health, safety, environment and community. The HSEC MS applies to all:

- Workplaces, sites and activities operated by Cooper Energy and under Cooper Energy's management or control;
- Exploration, construction and development activities under Cooper Energy management or control; and
- Cooper Energy employees, contractors and visitors on Cooper Energy sites, in offices and on activities such as offshore inspections, construction and development projects.

All personnel are expected to be familiar with, and comply with, the requirements of the HSEC MS.

6.2 Training and Competency

Regulation 14(5) of the OPGGS(E) Regulations (Cwlth) and Regulation 16 (5) of the OPGGS Regulations (Vic) require that the implementation strategy detail measures for ensuring that employee and contractors working on or in connection the activity are aware of their responsibilities regarding implementing the EP, including emergency response situations.

6.3 Emergency Response

Cooper Energy manages emergencies from the Gippsland Offshore Operations in accordance with the Cooper Emergency Management Plan (COE-ER-ERP-0001) (CEMP). The purpose of the CEMP is to provide the Cooper Energy Incident Management Team (IMT) with the necessary information to respond to an emergency affecting operations or business interruptions. Specifically, this plan:

- Describes the Emergency Management Process;
- Details the response process; and
- Lists the roles and responsibilities for the IMT members.

6.3.1 Emergency (Oil Spill) Response Arrangements

The Cooper Energy Offshore Victoria OPEP (VIC-ER-EMP-0001) and Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (VIC-ER-EMP-0002) provide for oil spill response and monitoring arrangements for Cooper Energy's Offshore Victorian assets.

Vessels will operate under the vessel's SMPEP (or equivalent appropriate to class) or spill clean-up procedures to ensure timely response and effective management of any vessel-sourced oil spills to the marine environment.

6.3.2 Testing Oil Spill Response Arrangements

Crisis and Emergency Preparedness and Response, the response arrangements will be tested:

- When they are introduced;
- When they are significantly amended;
- Not later than 12 months after the most recent test.

The effectiveness of response arrangements will be measured by the performance standards for each exercise type. Exercises will be documented, and corrective actions/recommendations tracked to closure.

6.3.3 Oil Spill Response Competency & Training

Personnel will have the appropriate competencies and training to undertake their roles and responsibilities in emergency situations.

Oil spill response training and competency records are maintained internally in accordance with Documented Information Standard Instruction (COE-MS-STI-0008).

6.4 Chemical Assessment and Selection

Cooper Energy's Offshore Environmental Chemical Assessment Process (COE-MS-RCP-0042) requires that chemicals that will be or have the potential to be discharged to the environment are assessed and approved prior to use. This process is used to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements.

6.5 Management of Change

The MoC Procedure (COE-MS-PCD-003) and MoC Standard Instruction (COE-MS-STI-0013) describes the requirements for dealing with change management.

The objective of the MoC process is to ensure that changes do not increase the risk of harm to people, assets or the environment. This includes:

- Deviation from established corporate processes;
- Changes to offshore operations and/or status of infrastructure;
- Deviation from specified safe working practice or work instructions/procedures;
- Implementation of new systems; and
- Significant change of HSEC-critical personnel.

Environmentally relevant changes include:

- New activities, assets, equipment, processes or procedures proposed to be undertaken or implemented that have the potential to impact on the environment and have not been:
    - Assessed for environmental impact previously, in accordance with the relevant standard; and
    - Authorised in the existing management plans, procedures, work instructions or maintenance plans.

- Proposed changes to activities, assets, equipment (including change of well or infrastructure status that may be undertaken under another EP), processes or procedures that have the potential to impact on the environment or interface with the environmental receptor;
- Changes to the existing environment including (but not limited to) fisheries, tourism and other commercial and recreational uses, and any changes to protective matter requirements;
- Changes to the requirements of an existing external approval (e.g. changes to conditions of environmental licences);
- New information or changes in information from research, stakeholders, legal and other requirements, and any other sources used to inform the EP; and
- Changes or updates identified from incident investigations, emergency response activities or emergency response exercises.

For any MoC with identified environmental impacts or risks, an impact/risk assessment will be undertaken to ensure that impacts and risks from the change can be managed to meet the nominated EPOs set out in the accepted EP as well as be ALARP and of an acceptable level.

6.5.1 Revisions of the EP

In the event that the proposed change introduces a significant new environmental impact or risk, results in a significant increase to an existing risk, or through a cumulative effect of a series of changes there is a significant increase in environmental impact or risk, this EP will be revised for re-submission to NOPSEMA and DEDJTR.

Where a change results in the EP being updated, the change/s are to be logged in the EP Change Register (Appendix D).

In addition, the titleholder is obligated to ensure that all specific activities, tasks or actions required to complete the activity are provided for in the EP. Regulation 17(5) of the OPGGS(E) Regulations (Cwlth) and Regulation 20(2) of the OPGGS Regulations (Vic) require that where there is a significant modification or new stage of the activity (that is, change to the spatial or temporal extent of the activity) a proposed revision of the EP will be submitted to NOPSEMA and DEDJTR.

6.6 Incident Reporting

As per Cooper Energy's Incident Management, Non-Conformity and Corrective Action Standard Instruction (COE-MS-STI-0020), Cooper Energy has a systematic method of incident reporting and investigation and a process for monitoring close out of preventative actions.

The incident reporting and investigation procedure defines the:

- Method to record, report, investigate and analyse accidents and incidents;
- Legal reporting requirements to the regulators within mandatory reporting timeframes;
- Process for escalating reports to Cooper Energy senior management and the Cooper Energy Board;
- Methodology for determining root cause;
- Responsible persons to undertake investigation; and
- Classification and analysis of incidents.

6.7 Environmental Performance Monitoring & Reporting

6.7.1 Emissions and Discharges

Emissions and discharge monitoring and records required for operations and vessel-based activities are detailed in Table 6-1.

Copies of emission and discharge records will be retained in accordance with the Documented Information Standard Instruction (COE-MS-STI-0008).

Table 6-1: Discharge and Emissions Monitoring

ASPECT	MONITORING	FREQUENCY	REQUIREMENT
OPERATIONS			
Routine release of hydraulic fluid	Chemical Type Volume	Daily	Distributed Control System
OFFSHORE ACTIVITY			
Fuel Use	Volume	Daily	Daily report
Waste	Volume sent ashore	As required	Daily report

6.7.2 Reporting

As required by Regulation 26C OPGGS(E) Regulations (Cwlth) and Regulation 31A OPGGS Regulations (Vic), Cooper Energy will submit an annual EP performance report to the regulator (NOPSEMA and DEDJTR). This report will provide sufficient detail to enable the Regulator to determine whether the environmental performance outcomes and standards in the EP have been met.

Cetacean observation data will be submitted to the DoEE via the Australian Marine Mammal Centre Data Portal

6.7.3 Audit and Inspection

Environmental performance of offshore activities will be audited and reviewed in several ways in accordance with Standard 18: Audit and Assessment. These reviews are undertaken to ensure that:

- Environmental performance standards to achieve the EPOs are being implemented, reviewed and where necessary amended;
- Potential non-compliances and opportunities for continuous improvement are identified; and
- Environmental monitoring requirements are being met.

The following arrangements review the environmental performance of the activity:

- A premobilisation inspection will be undertaken for offshore vessels to ensure it will meet the requirements of the EP; and
- HSEC inspections will be undertaken throughout the offshore activity to ensure ongoing compliance with the EP requirements.

6.7.4 EP Compliance

Cooper Energy shall track compliance with the controls contained in the EP and assess the effectiveness of the implementation strategy.

Opportunities for improvement or non-compliances noted will be communicated to relevant personnel at the time of the inspection/audit to ensure adequate time to implement corrective actions. The findings and recommendations of inspections or audits will be documented and distributed to relevant personnel for comment, and any actions tracked until completion.

Results from the environmental compliance tracking will be summarised in the annual EP performance report submitted to NOPSEMA and DEDJTR.

6.7.5 Management of Non-conformance

In response to any EP and environmental audits and inspections non-compliances, corrective actions will be implemented and tracked to completion as per the Incident management, Non-Conformity and Corrective Action Standard Instruction (COE-MS-STI-0020).

Corrective actions will specify the remedial action required to fix the breach and prevent its reoccurrence and is delegated to the person deemed most appropriate to fulfil the action. The action is closed out only when verified by the appropriate Manager and signed off. This process is maintained through the Cooper Energy corrective action tracking system.

Where more immediacy is required, non-compliances will be communicated to relevant personnel and responded to as soon as possible. Where relevant the results of these actions will be communicated to the offshore crew during daily toolbox meetings or at daily or weekly HSEC meetings.

Cooper Energy will carry forward any non-compliance items for consideration in future operations to assist with continuous improvement in environmental management controls and performance outcomes.

6.8 Records Management

In accordance with the Regulation 27 of the OPGGS(E) Regulations (Cwlth) and Regulation 32 of the OPGGS Regulations (Vic), Cooper Energy will store and maintain documents or records relevant to the EP in accordance with the Documented Information Standard Instruction (COE-MS-STI-0008).

.

7 Stakeholder Consultation

Cooper Energy has undertaken stakeholder engagement in preparation of the Gippsland Offshore Operations EP. Stakeholder identification involved the following:

- Reviewing the social receptors identified in the existing environment section;
- Reviewing existing stakeholders identified as relevant and contained within the Cooper Energy stakeholder register (Gippsland Basin);
- Reviewing previous BMG, PB, Sole and drilling campaign consultation records;
- Conversing with existing stakeholders to identify potential new stakeholders or changes to stakeholder contacts or consultation preferences;
- Reviewing Commonwealth and State fisheries jurisdictions and fishing effort in the region; and
- Reviewing the Australian Government Guidance Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area.

Stakeholders identified and contacted for this activity, grouped by the categories listed under OPGGS(E)R Regulation 11A, are listed in Table 7-1.

Table 7-1: Stakeholders for the Sole Development Project

Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
Australian Fisheries Management Authority (AFMA)	Australian Hydrological Service (AHS)
Australian Maritime Safety Authority (AMSA)	
Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP may be relevant	
DEDJTR – Victorian Fishery Authority	DEDJTR - Transport Victoria - Marine Pollution Team
DELWP - Marine National Parks and Marine Parks	Transport Safety Victoria (Maritime Safety)
The Department of the responsible State Minister, or the responsible Northern Territory Minister	
DEDJTR – Earth Resources Regulation (ERR)	
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
Fisheries:	
Abalone Victoria (Central Zone) (AVCZ)	Australian Southern Bluefin Tuna Industry Association
Commonwealth Fisheries Authority	Eastern Victoria Sea Urchin Divers Association

Eastern Victoria Sea Urchin Divers Association	Eastern Zone Abalone Industry Association
Eastern Victorian Rock Lobster Industry Association	Lakes Entrance Fishermen's Society Co-operative Limited (LEFCOL)
Port Franklin Fishermen's Association	Seafood Industry Victoria (SIV)
South-east Fishing Trawl Industry Association (SETFIA)	Southern Rock Lobster Ltd
Southern Shark Industry Alliance (SSIA)	Sustainable Shark Fishing Inc. (SSF)
Victorian Recreational Fishers Association (VRFish)	Victorian Rock Lobster Association (VRLA)[SIV]
Victorian Scallop Fisherman's Association	
Any other person or organisation that the Titleholder considers relevant	
Community interests:	
Abalone Council Australia	Australian Oceanographic Services Pty Ltd
San Remo Fishing Cooperative	Scuba Divers Federation of Victoria (SDFV)

7.1 Provision of Information

7.1.1 Initial Consultation

An extensive program of stakeholder engagement commenced in August 2015 (as Santos) to support the Sole Development Project, covering onshore, State and Commonwealth waters. Engagement included public open forums and information sessions in Orbost and Marlo.

Commencing in 2017, Cooper Energy has provided regular campaign brochures to relevant stakeholders outlining upcoming activities in the Otway and Gippsland Basins.

Recently (November 2018) a brochure was provided to relevant stakeholders describing Cooper Energy's plans in the Otway and Gippsland Basins for 2019, including information on the Sole, PB and BMG operations.

Information relevant to stakeholders including brochures are available on the Cooper Energy website (http://www.cooperenergy.com.au/) for interested members of the public to access.

7.1.2 Ongoing Consultation

Cooper Energy updates local fishers' plotters or initiates other 'awareness' activities based upon the results of a regular SETFIA Fisheries ALARP Assessment, a methodology developed in conjunction with SETFIA, which establishes through an assessment of risk factors, any increases in commercial fishing risk. Mitigation strategies are developed in conjunction with SETFIA which includes the identifying new vessel masters, new fishing vessels, increases in fishing activities or fishery closures. Cooper Energy maintains a register of fishing vessel and the currency of vessel 'plotter information' which is regularly maintained.

Approximately four (4) weeks prior to offshore activity commencing, Cooper Energy will provide relevant stakeholder's further information including:

- Type of activity;
- Location of activity: coordinates and/or map;

- Timing of activity: start and finish date and duration;
- Vessel(s), vessels details including call sign and contact;
- Cooper Energy contact person.

Cooper Energy will continue to identify new or changes to relevant persons through ongoing consultation with established stakeholders including peak industry bodies.

8 References

Barton J, Pope A and Howe S. 2012. Marine protected areas of the Flinders and Twofold Shelf bioregions Parks Victoria, Melbourne, Vic available at http://hdl.handle.net/10536/DRO/DU:30047221

Boon P, Allen T, Brook J, Carr G, Frood D, Harty C, Hoye J, McMahon A, Mathews S, Rosengren N, Sinclair S, White M and Yugovic J. 2011. Mangroves and Coastal Saltmarsh of Victoria, Distribution, Condition, Threats and Management. Institute for Sustainability and Innovation, Victoria University.

CEE Consultants. 2003. Sole Development (Patricia Baleen Extension) Technical Report, Marine Biological Issues, August 2003, CEE Consultants Pty Ltd.

Commonwealth of Australia. 2009. National Biofouling Management Guidance for the Petroleum Production and Exploration Industry

Commonwealth of Australia. 2012. Conservation Management Plan for the Southern Right Whale

Commonwealth of Australia. 2013. The Recovery Plan for the White Shark (*Carcharodon carcharias*)

Commonwealth of Australia. 2015. Conservation Management Plan for the Blue Whale 2015–2025

Commonwealth of Australia. 2017. Recovery Plan for Marine Turtles in Australia.

Cooper Energy. 2018. Sole-3 Basic Data Report (SOL-DC-REP-017) Cooper Energy Report.

DOTIS (2018) Discovery of Sound in the Sea. Determine if a sound affects a marine mammal. Discovery of Sound in the Sea. Accessed November 2018 < https://dosits.org/animals/effects-of-sound/determine-if-a-sound-affects-a-marine-animal/>

DSE. 2008 National Recovery Plan for the Australian Grayling *Prototroctes maraena.*

DSEWPaC. 2011 Department of Sustainability, Environment, Water, Population and Communities. 2011. National recovery plan for threatened albatrosses and giant petrels 2011-2016, Commonwealth of Australia, Hobart.

DSEWPaC. 2013 Recovery Plan for the White Shark (*Carcharodon carcharias*). Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/recovery-plan-white-shark-carcharodon-carcharias

Geraci, J.R. and St. Aubin, D.J. 1988. Synthesis of Effects of Oil on Marine Mammals. Report to U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, OCS Study. Ventura, California.

Hannay, D, MacGillivray, A, Laurinolli, M & Racca, R 2004, Source Level Measurements from 2004 Acoustics Programme, Sakhalin Energy, pp. 66.

Hewitt, C.L., Martin, R.B., Sliwa, C., McEnnulty, F.R., Murphy, N.E., Jones, T. and Cooper, S. (eds). 2002. National introduced marine pest information system. Available online http://www.marinepests.gov.au/Pages/default.aspx Accessed 04 May 2017

IMCRA Technical Group. 1998. Interim Marine and Coastal Regionalisation for Australia: an ecosystem-based classification for marine and coastal environments. Version 3.3. Interim Marine

and Coastal Regionalisation for Australia Technical Group. Environment Australia, Commonwealth Department of the Environment. Australia.

McCauley, R.D. 1998. Radiated underwater noise measured from the drilling rig ocean general, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Prepared by Rob McCauley for Shell Australia.

McCauley, R.D. 2004. Underwater sea noise in the Otway Basin – drilling, seismic and blue whales. Report prepared by Centre for Marine Science and Technology, Curtin University, for Santos Ltd McIntyre, A.D. and Johnson, R. 1975. Effects of nutrient enrichment from sewage in the sea. In: ALH Gameson, ed. Discharge of sewage from sea outfalls. New York, Pergamon Press. pp. 131–141.

NSF 2011. Final Programmatic Environmental Impact Statement/Overseas. Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. National Science Foundation, Arlington, VA.

NMFS 2013. *Marine Mammals: Interim Sound Threshold Guidance* (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.
http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

NMFS. 2018. Marine Mammal Acoustic Thresholds
https://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html

NERA. 2018. Environment Plan Reference Case Consequence Analysis of an Accidental Release of Diesel. National Energy Resources Australia. Reference Case 2018:1003.

OMV Australia. 2002. Drilling Operations End of Well Report; Appendix 2 of Sole-2 Well Completion Report. OMV Australia Pty Ltd.

OMV. 2003. Sole Development Project Pipeline Route Survey. Prepared by Thales GeoSolutions (Australasia) Limited for OMV Australia Pty Ltd Report No: 3497C1. Rev 1. 211pp.

OSPAR. 2014. Establishment of a list of Predicted No Effect Concentrations (PNECs) for naturally occurring substances in produced water. OSPAR Commission. OSPAR Agreement: 2014–05

OzCoasts. 2015. NRM Reporting Tools – National Intertidal/Subtitdal Benthic Habitat. Geoscience Australia, Australian Government. Available from: http://www.ozcoasts.gov.au/nrm_rpt/habitat_extent.jsp. Accessed 1 Aug 2017.

Parks Victoria. 2003. Victoria's System of Marine National Parks and Marine Sanctuaries 2003-2010 available at http://www.parkweb.vic.gov.au/1process_content.cfm?section=85&page=28

Paulay, G. Kirkendale, L. Lambert, G. and Meyer, C. 2002. Anthropogenic biotic interchange in a coral reef ecosystem: A case study from Guam. Pacific Science 56(4): 403–422

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D., Bartol, S., Carlson, T., Coombs, S., Ellison, W. T., Gentry, R., Halvorsen, M. B., Løkkeborg, S., Rogers, P., Southall, B. L., Zeddies, D., and Tavolga, W. N. 2014. "Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report," ASA S3/SC1.4 TR-201.4 prepared by ANSI Accredited Standards Committee Rationale and Background Information (Chapter 8)

RPS-APASA. 2012. Oil Spill Risk and Exposure Modelling for 120 l/day of BMG Condensate, Email B. King to L. Chapman.

ROC. 2010. Petro-lab Report Basker Condensate (File R-10074).

Santos. 2014. Baleen-4 and Patricia-2 (VIC/L21) Well Operations Management Plan (Doc No: 9016-289-PLA-0001).

Santos. 2015. Patricia-Baleen Pipeline VIC/PL31 and VIC/PL31(V) Pipeline Safety Case – Non-Operational Phase (Doc No: PB-STO-8200-002).

Threatened Species Scientific Committee (TSSC). 2013. Commonwealth Conservation Advice for Subtropical and Temperate Coastal Saltmarsh. Threatened Species Scientific Committee. Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/118-conservation-advice.pdf. Accessed 31 Jul 2017

United Nations Environment Programme (UNEP). 1985. GESAMP: Thermal discharges in the marine environment. UNEP Regional Seas Reports and Studies No. 45. Victoria, Rev 2 (Project No: Q0036)

World Health Organization (WHO). 2000. Ethylene Glycol: environmental aspects. Concise International Chemical Assessment Document 22. Geneva, Switzerland. Viewed online on 05 March 2018 at http://www.who.int/ipcs/publications/cicad/en/cicad22.pdf.