BMG Non-Production Phase Summary Environment Plan

Upstream PS Controlled Document

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Revision history

5	24/07/2017	Updated for NOPSEMA Comments	L Chapman	J Hinks	L Chable
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3	13/07/2014	Changes made consistent with the National Plan and Revision for change of Licence Holder/Environmental Operator from ROC to Cooper	LC	GW	LC
2	24/01/2014	Changed Facility Operator name and Operations Manager changed to L Chable	LC	GW	LC
1	04/04/2013	Updated now guard vessel has been removed from the location	LC	RT	JC
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Rev.	**Issue date**	**Revision summary**	**Originator**	**Reviewer**	**Approver**

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1 Introduction

Thus Environment Plan summary has been prepared to meet Regulation 11(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGSER) and summarises the information provided within the BMG Non-Production Phase (NPP) Environment Plan (EP) accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

1.1 Background

1.1.1 Titleholder & Operator

Cooper Energy Limited ('Cooper') holds a 100% interest and is the titleholder of the Basker-Manta-Gummy (BMG) oil and gas field in Petroleum Retention Leases VIC/RL13, VIC/RL14 and VIC/RL15 in eastern Bass Strait.

Upstream Production Solutions Pty Ltd (Upstream PS) is the nominated 'Facility Operator' of the subsea assets during the Non Production Phase (NPP) pursuant to the *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* and accepted by NOPSEMA.

1.1.2 Development History/Context

The BMG Field (Phase 1 Oil Development) was developed in 2005 utilising a leased Floating Production Storage Offloading (FPSO) vessel, *Crystal Ocean*. This allowed for recovery of hydrocarbons through a series of subsea wells connected back to the vessel. In 2010, the Phase 1 operation was deemed non-economic. The *Crystal Ocean*, prior to leaving the field in 2011, depressured, flushed and preserved with inhibited water the BMG subsea equipment which previously contained hydrocarbons. Further deconstruction activity undertaken in 1Q 2012 removed mooring systems and all mid-water equipment; and undertook trenching activities on the Basker-6 flowline. The residual subsea infrastructure will now be left under 'care and maintenance' pending a development decision on the Manta Gas Development. This phase, post Phase 1 Oil Development and before the Phase 2 (Manta Gas Development), is deemed the BMG Non-Production Phase (NPP).

A Manta Gas Development is now being considered by Cooper[1]. In the event that the review of future development alternatives deems a Manta Gas Development not economic, the existing BMG development will enter an abandonment phase.

[1] Decision is dependent on confirmation of reserves from possible drilling in 2018.

2 Activity Location

The BMG oil and gas fields, located in Retention Leases VIC/RL13, VIC/RL14 and VIC/RL15, are situated in the Commonwealth waters of Bass Strait approximately 55km from the Victorian Coast (south of Cape Conran) and 15km east of the Flounder oil and gas field (refer Figure 2-1).

These Leases are administered by the National Offshore Petroleum Titles Administrator (NOPTA) on behalf of the Australian Commonwealth Government and cover an area of approximately 531 km^2 with water depths across the licence areas varying from 135m to 350m.

Equipment remaining from the BMG Phase 1 Oil Development during the NPP is detailed in Section 3.1. NPP equipment include all BMG wells and associated well-related equipment, the Basker-A Manifold (BAM) and all flowlines and umbilicals (excluding dynamic sections previously connected to the FPSO, *Crystal Ocean*).

The coordinates for the BMG wells and equipment are provided in Table 2-1. The BMG Petroleum Safety Zone (PSZ) coordinates are provided in Table 2-2 and the gazetted[2] NPP PSZ provided diagrammatically in Figure 2-2.

All untrenched NPP subsea equipment is located within a gazetted BMG PSZ.

[2] A443819 was gazetted on 15th October 2015. Refer to http://www.nopsema.gov.au/assets/Gazettal-notices/A443819.pdf.

Figure 2-1 Regional Location of the BMG Field (NOPTA, 2016)

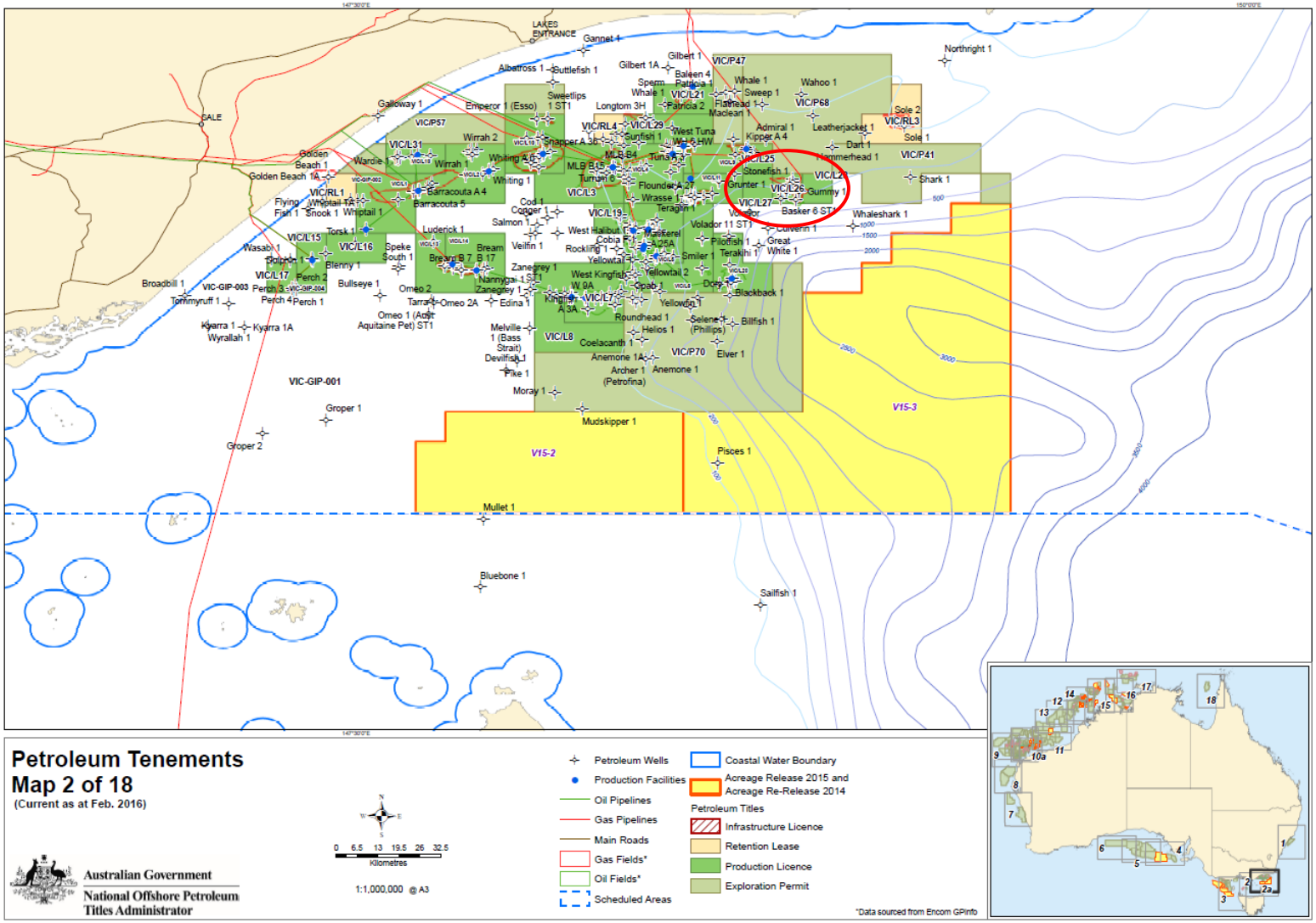


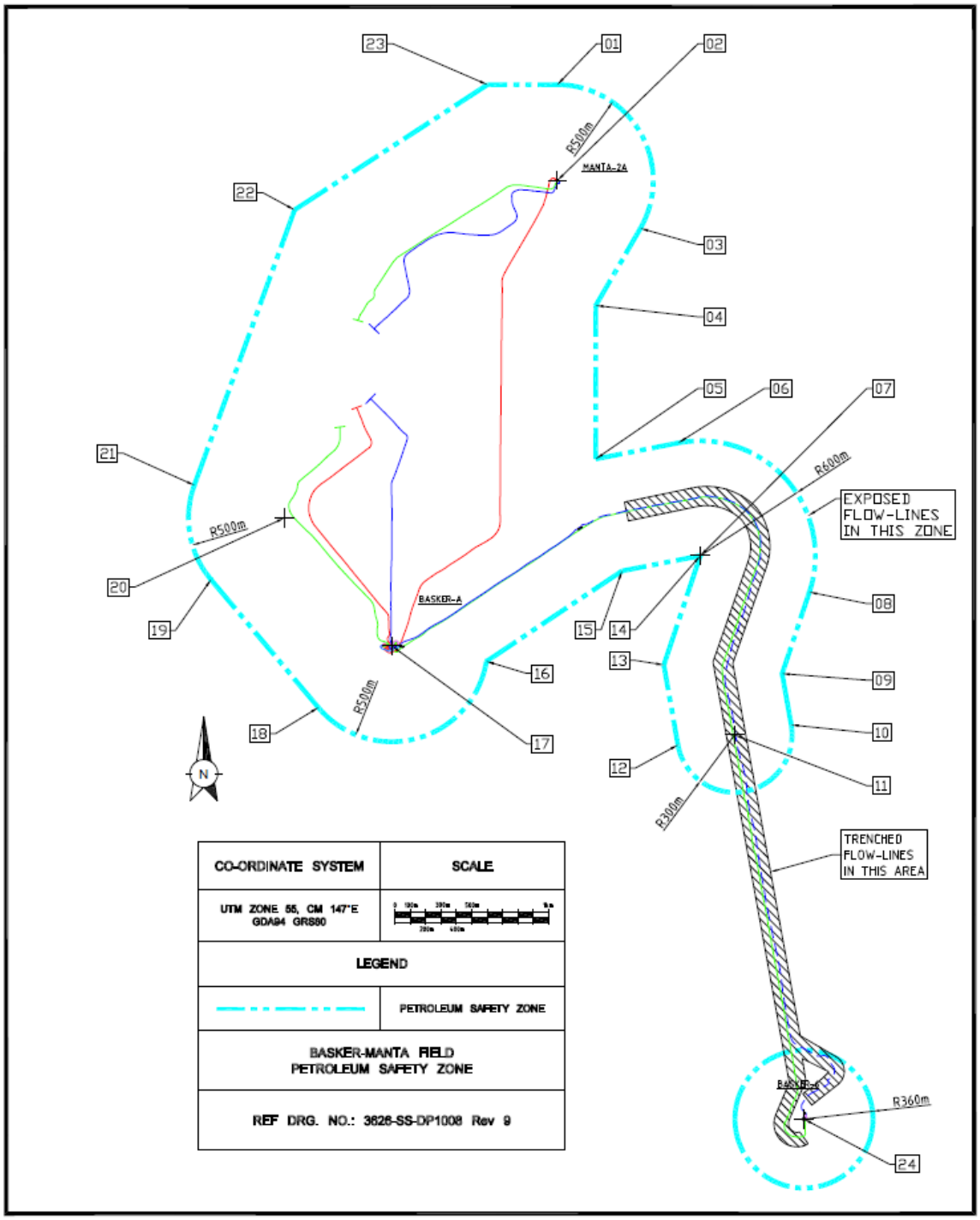
Table 2-1: BMG Infrastructure Coordinates (Datum: GDA94)

Locations	Longitude (E)	Latitude (S)	Water Depth (m)
Basker-2 Well (B2)	148º 42' 24.72"	38º 17' 58.51"	155
Basker-3 Well (B3)	148º 42' 24.94"	38º 17' 58.97"	155
Basker-4 Well (B4)	148º 42' 23.58"	38º 17' 58.86"	155
Basker-5 Well (B5)	148º 42' 23.80"	38º 17' 59.31"	155
Basker-6 Well (B6)	148° 43' 54.76''	38° 19' 17.47''	263
Basker-7 Well (B7)	148° 42' 22.31"	38° 17' 58.79"	155
Manta-2A Well (M2A)	148º 42' 58.03"	38º 16' 39.41"	135
Basker-A Manifold (BAM)	148° 42' 24.32"	38° 17' 58.74"	155

Table 2-2 BMG NPP PSZ Coordinates

Petroleum Safety Zone Boundary- MGA Coordinates (GDA94)			
No.	LATITUDE S	LONGITUDE E	COMMENTS
01	38° 16' 23.21"	148° 42' 57.63"	
02	38° 16' 39.42"	148° 42' 58.01"	MANTA-2A, CNTR 500m RAD.
03	38° 16' 47.27"	148° 43' 16.02"	
04	38° 17' 00.48"	148° 43' 06.75"	
05	38° 17' 26.45"	148° 43' 07.36"	
06	38° 17' 23.47"	148° 43' 25.02"	
07	38° 17' 42.50"	148° 43' 30.18"	SAME AS 14, CNTR 600m RAD.
08	38° 17' 48.32"	148° 43' 53.75"	
09	38° 18' 02.21"	148° 43' 48.23"	
10	38° 18' 10.86"	148° 43' 50.38"	
11	38° 18' 12.72"	148° 43' 38.26"	CNTR 300m RAD.
12	38° 18' 14.59"	148° 43' 26.14"	
13	38° 18' 01.11"	148° 43' 22.79"	
14	38° 17' 42.50"	148° 43' 30.18"	SAME AS 07
15	38° 17' 45.32"	148° 43' 13.44"	
16	38° 18' 01.06"	148° 42' 44.69"	
17	38° 17' 58.74"	148° 42' 24.32"	MANIFOLD, CNTR 500m RAD.
18	38° 18' 09.40"	148° 42' 08.80"	
19	38° 17' 48.07"	148° 41' 45.23"	
20	38° 17' 37.42"	148° 42' 00.75"	CNTR 500m RAD.
21	38° 17' 32.15"	148° 41' 41.28"	
22	38° 16' 45.22"	148° 42' 01.72"	
23	38° 16' 23.42"	148° 42' 42.63"	
24	38° 19' 17.54"	148° 43' 54.70"	BASKER-6, CNTR 360m RAD.

Figure 2-2 Current BMG Development Layout and NPP PSZ



3 NPP Activity Description

3.1 Equipment Summary and Status

3.1.1 Equipment Summary

The following wells and subsea equipment has been preserved on the seabed for the NPP:

- 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 BAM and three (3) 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). This remains unchanged from the configuration adopted during the BMG Phase 1 Oil Development.

3.1.2 Equipment Status

The BMG NPP equipment which remains in the field has been left as follows:

- Wells:
  - All BMG wells have been left with at least two independent confirmed and tested mechanical barriers with one down-hole barrier between the petroleum reservoir and marine environment;
  - The chemical isolation valves (CIV) on chemical supply lines were closed, tested and isolations confirmed;
  - All hydraulically actuated down-hole Interval Control Valves (ICVs) were closed[3] where practical;
  - ROV operable control line isolation valves on the subsea trees were closed[4];

[3] Note the Basker-2 ICV has not been closed.

  - Annulus Chemical Injection (ACI) ROV Operable CIV on B2, B3, B4, B5, M2A were closed.
- Flowlines:
  - Flowlines have been flushed of hydrocarbons and displaced with inhibited freshwater to protect against internal corrosion;
  - Flowline sections where the dynamic section has been removed (i.e. flowlines previously connected to the FPSO) have had blinds fitted to the static flowline sections which have been tested and confirmed leak tight. Some re-pressurisation (gas) of the flowline system has occurred as a result of the work scope completed in 1Q 2012 and further small amounts of gas ingress may occur over time due to valve passing.
- Service Control Lines:
  - Down-hole control lines to the well downhole valves have been left filled with TransaquaHT2™ with the control line isolation valves closed;
  - Other chemical injection service lines have been displaced with uninhibited freshwater and capped.

3.1.3 Corrosion Potential

3.1.3.1 Internal Corrosion

The risk of internal corrosion of the subsea facilities is minimized due to a combination of the following:

- Wells are shut-in and production has ceased, limiting exposure to corrosive production fluids.
- At the time of field shut-in the Basker and Manta subsea flowlines and subsea production and gas lift pipework on subsea trees and subsea manifolds were flushed to remove free hydrocarbons and filled with inhibited water for NPP. The flushing and fill activities included the following (Roc Oil, 2011b):
  - Facilities flushed with two volumes of hot water to remove any free oil.
  - Facilities flushed with cold seawater to ensure oil in water content was below 30 mg/L.
  - Facilities soaked for 2 hours with biocided (Biocide EC7338) seawater to remove any existing bacteria.
  - Facilities flushed with two volumes of freshwater to remove chlorides and reduce chloride level to below 1000ppm.
  - Facilities filled with inhibited fresh water dosed with Hydrosure 0-3760RD Dyed (film-forming amine corrosion inhibitor, biocide, oxygen scavenger and dye).
  - The Basker 6 production flowline was displaced to inhibited water when the well was shut-in in 2009.
- The materials of construction of subsea trees and subsea manifolds were selected to suit the expected production fluids. Subsea tree and manifold materials include UNS S41000 martensitic stainless steel valve blocks with Inconel 625 (UNS N06625) weld overlay on all seal faces and valve cavities and duplex stainless steel SAF2205 flow-spools. Subsea Trees are designed in accordance with API 6A (19th) and API 17D (1st), PSL 3, Material

[4] Except the B2 and B5 SSSV isolation valves which could not be closed by ROV. B2 SSSV valve has been isolated from the reservoir by installation of a hydraulic capping plate during DWIC activities. The B5 SSSV has been isolated from the reservoir via the B5 reservoir abandonment activities during DWIC.

Class FF modified and Temperature Class V. (Anzon Australia, 2005; Anzon/AGR Australia, 2008).

- The materials of construction of flexible flowlines were selected to suit the expected production fluids. The flexible flowlines have been designed and supplied in accordance with API 17J.

3.1.3.2 External Corrosion

The risk of external corrosion of the subsea facilities is minimized due to a combination of the following:

- Epoxy paint coatings on subsea equipment;
- Subsea equipment cathodic protection systems designed in accordance with DNV RP B401;
- Coatings and cathodic protection systems are routinely inspected by general visual inspection (GVI) and CP stab measurements to confirm ongoing effectiveness through the NPP in accordance with the BMG-NPP Subsea Integrity Management Plan.

3.1.3.3 Subsurface Facilities

As part of the risk assessment associated with the collation of the BMG Well Operations Management Plan (WOMP) in April 2016, Cooper commissioned corrosion modelling to determine the integrity status of BMG subsurface facilities and to provide an assessment of the corrosion risks during the NPP (as extended).

The Strategic Chemistry Corrosion Study concluded that in the short-term there is no significant risk to the BMG wells due to corrosion. In the longer term, collection of measured data would assist in calibrating the modelling to actual conditions.

To obtain these measurements well intervention would be required. Well intervention is outside the scope of this current EP. A new EP would be submitted to NOPSEMA for this activity.

3.2 Field Characteristics

Table 3-1 provides details of the BMG Crude Composition and gas compositions (Shedden Udhe, 2006). Crude details are provided for reference only. With the current status of the Basker and Manta wells, liquid hydrocarbon leakage is not expected through the well valves.

Table 3-1: BMG Crude and Gas Composition

Component	Unit	Crude Average Oil	Gas Average
H_2S (note 1)	ppm	20	20
CO_2	Mol%	6.44	5.101
N_2	Mol%	0.10	0.448
C_1	Mol%	46.48	76.782
C_2	Mol%	7.19	7.646
C_3	Mol%	4.84	3.897
i-C_4	Mol%	1.03	0.659
n-C_4	Mol%	1.83	1.137
i-C_5	Mol%	0.70	0.398
n-C_5	Mol%	0.82	0.381
C_6	Mol%	1.51	0.499

Component	Unit	Crude Average Oil	Gas Average
C_7	Mol%	3.27	0.880
C_8	Mol%	2.21	0.693
C_9	Mol%	2.34	0.446
C_{10}	Mol%	1.66	0.244
C_{11}	Mol%	1.14	0.131
C_{12}	Mol%	0.97	
C_{13}	Mol%	1.10	
C_{14}	Mol%	1.03	
C_{15}	Mol%	1.32	
C_{16}	Mol%	1.04	
C_{17}	Mol%	1.32	
C_{18}	Mol%	0.93	
C_{19}	Mol%	0.90	
C_{20}	Mol%	0.94	
C_{21}	Mol%	0.96	
C_{22}	Mol%	0.96	
C_{23}	Mol%	0.96	
C_{24}	Mol%	0.94	
C_{25}	Mol%	0.94	
C_{26}	Mol%	0.83	
C_{27}	Mol%	0.81	
C_{28}	Mol%	0.63	
C_{29}	Mol%	0.54	
C_{30+}	Mol%	1.32	
C_{12+}	Mol%		0.657

Note 1: Level specified for purpose of design in 2006. During drilling activities on Basker Manta, H_2S levels of up to 6 ppm were measured in produced gas during clean-up flows of the wells (Roc, 2011).

3.3 NPP Activities

3.3.1 Inspection, Maintenance & Repair (IMR) Activities

3.3.1.1 General Activities

During the NPP, regular visual inspection and monitoring of wells and subsea equipment via ROV will be a key activity. The survey activities may include use of an inspection class or a work-class Remotely Operated Vehicle (ROV) to undertake minor intervention activities such as Cathodic Protection (CP) measurements, anode replacement, general visual inspection, service line/hydraulic capping plate removal/re-installation, marine growth removal, debris or fishing net removal, subsea control unit change-out and sand-bag replacement or mattress deployment on Electrical/Hydraulic Flying Leads (EFL/HFLs).

The survey vessel is not expected to anchor in the field whilst undertaking survey activities. Given the short period of time that the vessel is expected to be at the BMG location undertaking the survey/inspection activity (14-21 days) no vessel refuelling at sea is expected.

Inspection of the BMG equipment has occurred on a risk-based cycle frequency basis since the departure of the *Crystal Ocean* FPSO from the Field (April, 2011). The scope of each inspection utilises a subsea asset integrity management process which determines the frequency of inspection, monitoring and maintenance on the BMG facility. Inspection frequencies could range from 1 to 5 years depending upon the assessment of potential threats and associated risks.

3.3.1.2 Inspection Activities

Inspection and monitoring of subsea equipment for external damage or movement will include inspection for:

- Any signs of dye (from inhibited water contained within equipment);
- Any signs of gas bubbling from wells or equipment;
- Any appreciable increase in marine growth across subsea equipment;
- Changes in sand or seabed distribution around wells or equipment;
- Any damage to equipment;
- Any foreign objects entangled on equipment;
- Any signs of corrosion on the subsea assets;
- Any changes to flowline and umbilical spans;
- Any sign of exposure of the trenched umbilical; and
- Any appreciable degradation of anodes;

Measurements of cathodic potential on subsea equipment shall also be taken on the schedule as determined by the Subsea Integrity Management Plan to assess the effectiveness of the cathodic protection system.

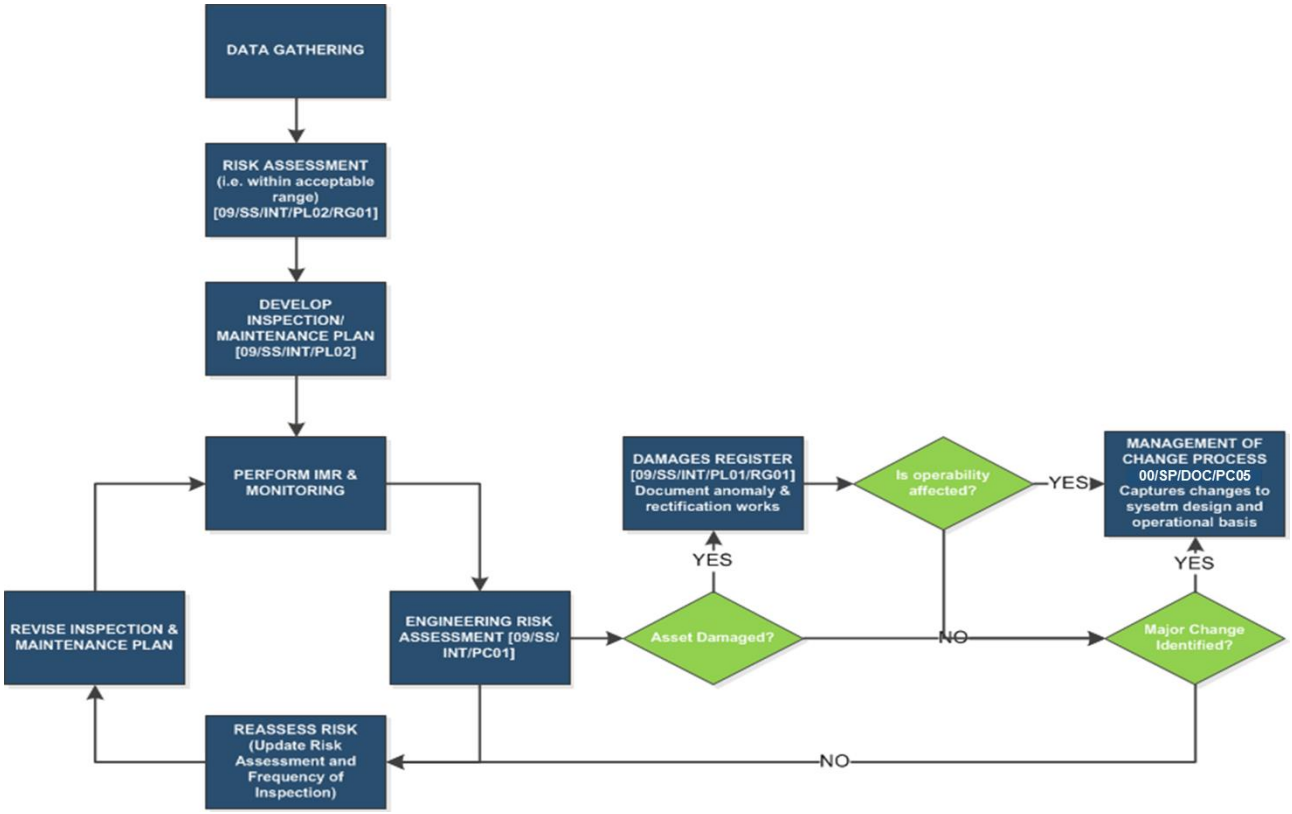
Inspection of the BMG equipment has occurred on a risk-based cycle frequency basis since the departure of the FPSO from the Field (April, 2011). The scope of each inspection has been as scheduled by the risk based subsea asset integrity management process. These inspections have provided integrity information for the facility during NPP. The BMG Subsea Integrity, Maintenance and Repair (IMR) Engineering Assessment Procedure[5] details the risk-based assessment process associated with the integrity inspection results and how this feed into, and determines the frequency of inspection, monitoring and maintenance on the BMG facility. This process is described diagrammatically in Figure 3-1

In accordance with the Integrity Management Plan for BMG Subsea Facilities inspection frequencies could range from 1 to 5 years depending upon the assessment of potential threats and associated risks.

The full inspection program (including mobilization and demobilization) is likely to take 2-3 weeks per event. In the event that leaking hydrocarbons are visible from any part of the subsea equipment, then the BMG Emergency Response Plan (ERP) and BMG Oil Pollution Emergency Plan (OPEP) may be activated (as required).

[5] This system is based on rationale and methodology of the Integrity Management of Subsea Pipeline Systems DNV Recommended Practice DNV RP-F116 and Cathodic Protection Design DNV Recommended Practice DNV RP-B401.

Figure 3-1: Subsea Asset Integrity Management Process



3.3.2 Support Arrangements

3.3.2.1 Aviation Support

Due to the expected size of vessel to be used for IMR activities helicopters are not expected to be used during NPP activities however may be used for observation of hydrocarbon spills during the NPP.

3.3.2.2 Vessel Support

IMR activities are undertaken with the aid of a survey vessel. Vessels may be contracted from international or Australian suppliers, when required and will vary depending on the proposed activity and vessel availability. However typical vessels are expected to be local service vessels. Vessels are expected to use Marine Diesel Oil (MDO) as a fuel source.

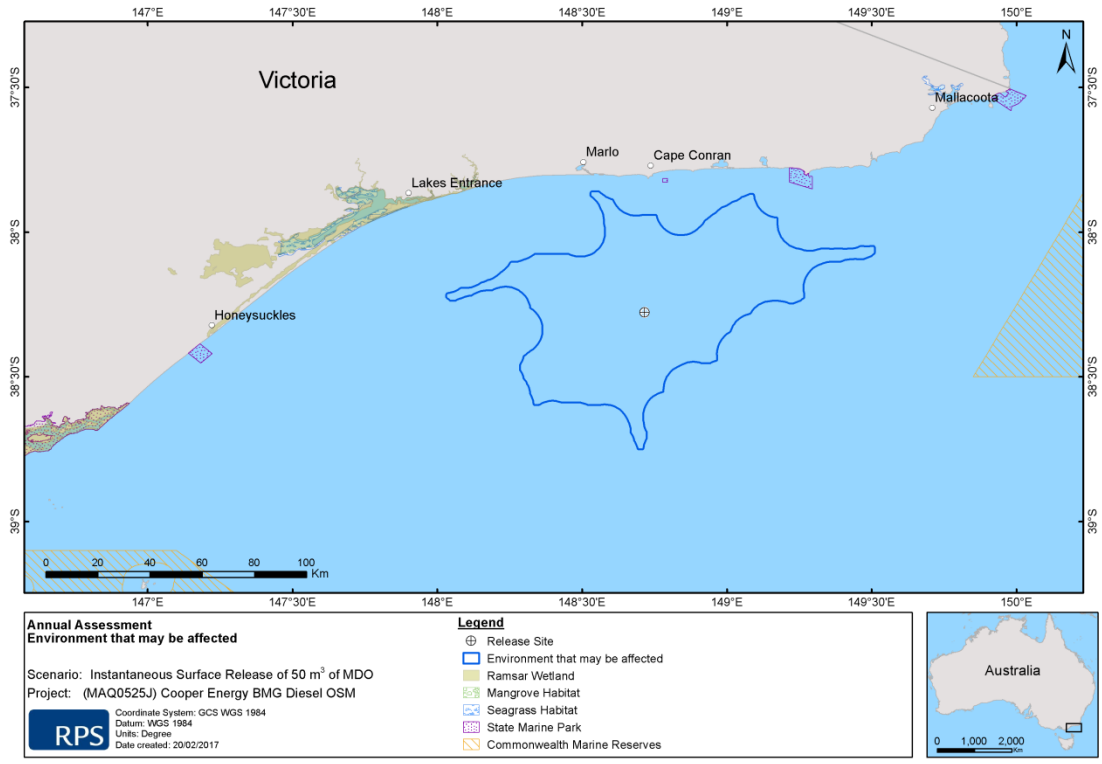
Locally sourced vessels are expected to mobilize from Lakes Entrance approximately 80 km north-west (NW) of the BMG assets. Larger vessels, if required are expected to utilise the Port of Eden or Geelong and may be sourced from international locations.

4 Receiving Environment

The BMG assets are located within the South-east marine region and twofold shelf marine bioregion as classified by the Integrated Marine and Coastal Regionalisation of Australia (IMCRA). This region extends from east of Wilson's Promontory to north of Tathra (NSW). The coastline is exposed with long sandy beaches broken by rocky headlands and numerous coastal lagoons. The sea surface temperatures in the area reflect the influence of warmer waters brought into Bass Strait by the East Australia current (EAC) (EA, 1998).

The receiving environment has been defined as the 'environment that may be affected (EMBA)' from the maximum credible oil spill footprint which might occur during NPP activities. This is defined as the area which is encompassed by the visible oil surface sheen (0.5µm) and low level entrained phase hydrocarbon (>672 ppb.hrs) from a 50 m^3 MDO spill (refer Figure 4-1). Note that the EMBA, given the distance of the BMG field from the adjacent Victorian coastline and the highly dispersive Bass Strait environment, does not lead to any measureable shoreline impacts and is predicted to remain in Commonwealth waters.

Figure 4-1: BMG NPP "Environment that may be affected"



4.1 Physical Environment

4.1.1 Bathymetry, Seabed and Shallow Geology

The BMG Retention Leases are located on the mid-outer continental shelf and the upper slopes of the Bass Canyon. The majority of the development lies on the mid-outer continental shelf north of the Bass Canyon shelf break (~135 m to 200 m). The seabed of the area is very slightly undulating and smooth with gradients no greater than 2º (1:30). Basker-6 infrastructure lies over the Bass Canyon shelf break on the canyon's upper slopes (263 m depth). There have been no seabed anomalies identified in the area (Fugro, 2007).

The Bass Canyon is an ESE-trending funnel-shaped submarine canyon 60 km long and 10–15 km wide at its mouth. The canyon is incised to a depth of more than 2000 m and is bounded in the north and south by steep bedrock walls 1000m in height. The main canyon floor, in water depths of more than 4000 m, is connected to the continental shelf by three large, deeply-incised tributary canyons and numerous smaller valleys (NOO, 2002) and is recognised for having important biological productivity (including significant fisheries) and unique oceanography (Commonwealth of Australia, 2003).

The seabed at and around the BMG wellheads is featureless with the seabed comprising of silty sand. The underlying geological structure is dipping and slightly irregular, grading from silty fine sand at the seabed to over consolidated sandy, silty clay at 10m below seabed.

4.1.2 Metocean Conditions

4.1.2.1 Climate

The region's climate is cool temperate, with cool wet winters and cool summers. It is influenced by rain bearing cold fronts that move from south-west to north-east across the region, producing strong winds from the west, north-west and south-west. In winter, when the subtropical ridge moves northwards over the Australian continent, cold fronts generally create sustained west to south-westerly winds and frequent rainfall in the region (McInnes and Hubbert, 2003). In summer, frontal systems are often more shallow and occur between two ridges of high pressure, bringing more variable winds and rainfall.

4.1.2.2 Winds

Bass Strait is located on the northern edge of the westerly wind belt known as the Roaring Forties. Occasionally, intense meso-scale low-pressure systems occur in the region, bringing very strong winds, heavy rain, and high seas. These events are unpredictable in intensity and behaviour, but are most common between September and February (McInnes and Hubbert 2003).

Wind data identifies a high occurrence of west-southwest winds throughout the year. Average monthly wind speeds are between 13.9 to 16.5 knots (25.7 to 30.5 km/hr) and maximum wind speeds between 39.9 to 49.7 knots (73.8 to 91.9 km/hr) (RPS-APASA, 2017).

4.1.2.3 Currents

Four major ocean currents affecting the BMG area are (Bax & Williams, 2000):

- *East Australian Current (EAC):* A southward-flowing open ocean current carrying warm, high-salinity, nutrient poor water from the north;
- *Zeehan Current:* Flows southward on the continental shelf, transporting warmer water down the west coast of Tasmania;
- *South Australian (Leeuwin) Current:* Carrying cool Bass Strait waters eastward driven by prevailing westerly winds; and
- *Antarctic Circumpolar Current:* An eastward flowing low salinity cooler current that gains strength south of Tasmania.

These water masses in the Tasman vacillate throughout the year. The warm EAC water predominates in summer, while the waters of the Zeehan Current and subantarctic waters cool the area in winter (NOO, 2002).

The EAC increases its speed with increased distance offshore, so most flow is located off the continental shelf. At 33° latitude, the current veers east, separating from the continental slope and diverting most flow east towards New Zealand. Despite this, the EAC injects large amounts

of warm, salty water into Bass Strait mostly during summer when the current extends further (NOO, 2002).

The Zeehan Current skirts the western end of Bass Strait and flows along the west coast of Tasmania, tracing the edge of the continental shelf. It is a shelf-break current, narrower, closer to shore, and moving much less water. In summer, the Zeehan leaves the coast at the southern end of Tasmania, heading south and east where its waters are mixed with the remnants of EAC current. In winter, the Zeehan moves faster and extends further around Tasmania, bringing waters up to four degrees colder than the EAC water onto the shelf and slope off eastern Tasmania. Where the currents converge mixing of cool and warm waters, upwellings of nutrient-rich waters provide a source of food for many marine species (NOO, 2002).

Vertical variation of currents is controlled by the decreasing influence of wind and increasing influence of sea-floor friction with depth. The waters of Bass Strait are usually well mixed between April and December but surface warming can cause weak stratification in calm summer conditions. When waters do exhibit stratification, a shear zone will result in sudden changes in current direction with depth. At such times, surface currents can be going in quite different directions to waters below the shear zone (GEMS, 2005).

During winter, the Bass Strait cascade occurs, a wintertime down-welling caused by cooling of the shallow waters of Bass Strait in the Gippsland Basin (Gibbs et al., 1986; Luick et al. 1994; cited in RPS-APASA, 2011). Down-welling currents that originate in the shallow eastern waters of Bass Strait flow down the continental slope to depths of several hundred metres or more into the Tasman Sea (Luick et al. 1994; cited in APASA, 2011).

Total surface currents measured at the Sole Field location, approximately 35 km NE of BMG, attained a mean speed of 0.4m/s, based on a 2 year storm return period, and ranged up to 1m/s, based on a 100 year storm return period (Anzon, 2005). Corresponding near-bottom currents measured between 0.2m/s and 0.5m/s for a 2 year and 100 year storm return period respectively.

4.1.2.4 Tides

Tides in Bass Strait vary in phase by about 3 to 4 hours from east to west (Lakes Entrance to Wilson's Promontory). Tidal movements in eastern Bass Strait are semi-diurnal with some diurnal inequalities (Jones and Padman, 1983; Easton, 1970) predominantly in a NE-SW direction. Tides inflow from the east and west during a rising (flood) tide and flow out to the east and west during a falling (ebb) tide (Esso, 2009). Tides show seasonal variation with spring tides of approximately 0.9m and neap tides of 0.6m. Strong tidal currents (~2 knots [~1m/s]) are characteristic of this area (Barton et al. 2012).

4.1.2.5 Sea Temperature

Monthly sea-surface water temperature according to the National Oceanographic Data Centre – World Ocean Atlas (www.metoc.gov.au) was found to vary seasonally from a minimum of 14.2ºC (July) to a maximum of 19.6ºC (February) (RPS-APASA, 2017). Waters were coldest throughout July to October and warmest throughout January to April. Salinity remained consistent throughout the year ranging from 35.3 to 35.7ppt (RPS-APASA, 2017).

4.1.2.6 Waves

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights. Storms may occur several times a month resulting in wave heights of 3 to 4 m or more (Esso, 2008).

4.2 Biological Environment

4.2.1 Benthic Environment

The near-shore fauna of Bass Strait is characterised by distinct species assemblages of reef fishes, echinoderms, gastropods and bivalves. Substantial variation was found in species composition between seasons, as well as between sites due to grain size, depth and sediment sorting (CEE Consultants, 2001). Bass Strait supports a diverse benthic invertebrate fauna. Benthic communities are varied and are principally determined by seafloor habitat. The marine invertebrates in the region include:

- Porifera (e.g., sponges);
- Cnidarians (e.g., jellyfish, corals, anemones, sea-pens);
- Bryozoans (microscopic filter feeders);
- Arthropods (e.g., sea spiders);
- Crustaceans (e.g., rock lobster, krill);
- Molluscs (e.g., bivalves, sea slugs, gastropods, abalone);
- Echinoderms (e.g., urchins, sea cucumbers); and
- Annelids (e.g., polychaete worms).

Studies by the Museum of Victoria (Wilson and Poore, 1987; Poore *et al.,* 1985) found that:

- Invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions. Results of sampling in shallower inshore sediments reported high diversity and patchy distribution (Parry *et al*., 1990);
- Many species are widely distributed across Bass Strait, suggesting heterogeneous sediments and many microhabitats (Esso, 2010); and
- Crustaceans and polychaetes dominate the in-faunal communities, many of which are unknown species (Esso, 2010).

4.2.2 Pelagic Environment (Protected Species)

A search of the Commonwealth Department of Environment and Energy's (DoEE) Environment Protected Matters database was undertaken for the BMG NPP EMBA. Table 4-1 details pelagic fauna identified in the Protected Matters Search, applicable management plans and relevant management actions. Species identified are likely to transit through the area with the exception of the pygmy blue whale and a number of albatross where the EMBA overlaps biologically important areas (BIA) (foraging) for these species.

Table 4-1: Threatened and Migratory Species which may occur in the BMG NPP EMBA

Scientific Name	Common Name	EPBC Act Status	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
FISH					
Carcharodon carcharias	Great white shark	Vulnerable, Migratory	Recovery Plan for the White Shark (SEWPC, 2013)	✓ [Known Distribution Area for species]	No threats applicable to NPP activities
Carcharias Taurus (east coast population)	Grey Nurse Shark	Critically Endangered	Recovery Plan for the Grey Nurse Shark (DoE, 2014)	X	No threats applicable to NPP activities
Isurus oxyrinchus	Shortfin mako shark	Migratory	-	X	-
Lamna nasus	Porbeagle shark	Migratory	-	X	-
Prototroctes maraena	Australian grayling	Vulnerable	National recovery plan for the Australian Grayling (DEWHA, 2008)	X	No threats applicable to NPP activities
Rhincodon typus	Whale shark	Vulnerable, Migratory	Whale Shark Recovery Plan 2005-10 (DEH, 2005 (Expired), Whale Shark TSSC Advice (2015a)	X	Evaluate risk of marine pollution and marine debris
CETACEANS					
Balaenoptera acutorostrata	Minke whale	Migratory	-	X	-
B. bonaerensis	Antarctic minke whale	Migratory	-	X	-
B. borealis	Sei whale	Vulnerable, Migratory	Sei Whale TSSC Conservation Advice (2015d)	X	Evaluate noise impacts to species Evaluate risk of vessel collision with species
B. edeni	Bryde's whale	Migratory	-	X	-
B. musculus	Blue whale	Endangered, Migratory	Blue whale Conservation Management Plan (DoE, 2015a)	✓ [Known Foraging Area for species]	Evaluate noise impacts to species Evaluate risk of vessel collision with species
B. physalus	Fin whale	Vulnerable, Migratory	Fin Whale TSSC Conservation Advice (2015b)	X	Evaluate noise impacts to species Evaluate risk of vessel collision with species
Caperea marginata	Pygmy right whale	Migratory	-	X	-
Eubalaena australis	Southern right whale	Endangered, Migratory	Conservation Management Plan for Southern Right Whale (SEWPC, 2012)	X	Evaluate noise impacts to species

Scientific Name	Common Name	EPBC Act Status	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
					Evaluate risk of vessel collision with species
Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory	Humpback Whale TSSC Conservation Advice (2015c)	X	Evaluate marine debris risk to species Evaluate risk of vessel collision with species
Orcinus orca	Killer whale	Migratory	-	X	-
Physeter macrocephalus	Sperm whale	Migratory	-	X	-
Lagenorhynchus obscures	Dusky dolphin	Migratory	-	X	-
REPTILES					
Caretta caretta	Loggerhead turtle	Endangered, Migratory	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017)	X	Evaluate marine debris risk to species Integrate oil pollution plans with National Plan requirements Offshore vessel lighting will be minimised as far as possible.
Chelonia mydas	Green turtle	Vulnerable, Migratory		X	
Dermochelys coriacea	Leatherback turtle	Endangered, Migratory		X	
Eretmochelys imbricata	Hawksbill turtle	Vulnerable, Migratory		X	
BIRDS					
Seabirds					
Diomedea antipodensis	Antipodean albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	✓ [Known Foraging Area for species]	Evaluate marine debris risk to species
Diomedea antipodensis gibsoni	Gibson's albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Diomedea epomophora	Southern royal albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Diomedea exulans	Wandering albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	✓ [Known Foraging Area for species]	Evaluate marine debris risk to species
Diomedea sanfordi	Northern royal albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Fregetta grallaria grallaria	White-bellied storm petrel	Vulnerable	-	X	-
Halobaena caerulea	Blue petrel	Vulnerable	Approved Conservation Advice for *Halobaena*	X	-

Scientific Name	Common Name	EPBC Act Status	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
			caerulea (blue petrel). (TSSC, 2015f)		
Macronectes giganteus	Southern giant-petrel	Endangered, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Macronectes halli	Northern giant-petrel	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Pachyptila turtur subantarctica	Fairy prion (southern)	Vulnerable	-	X	-
Phoebetris fusca	Sooty albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Pterodroma leucoptera leucoptera	Gould's petrel	Endangered	-	X	-
Puffinus carneipes	Flesh-footed shearwater	Migratory	-	X	-
Thalassarche bulleri	Buller's albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche bulleri platei	Northern Buller's albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche cauta cauta	Shy albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	✓ [Known Foraging Area for species]	Evaluate marine debris risk to species
Thalassarche cauta steadi	White-capped albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche chrysostoma	Grey-headed albatross	Endangered, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche eremita	Chatham albatross	Endangered, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche impavida	Campbell albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	✓ [Known Foraging Area for species]	Evaluate marine debris risk to species
Thalassarche melanophris	Black-browed albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	✓ [Known Foraging Area for species]	Evaluate marine debris risk to species
Thalassarche salvini	Salvin's albatross	Vulnerable, Migratory	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Thalassarche sp. nov.	Pacific albatross	Vulnerable	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Shorebirds (No impacts Expected)					
Apus pacificus	Fork-tailed swift	Migratory	-	X	Not Applicable

Scientific Name	Common Name	EPBC Act Status	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
Calidris ferruginea	Curlew sandpiper	Critically Endangered, Migratory	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	X	Not Applicable
Pandion haliaetus	Osprey	Migratory	-	X	Not Applicable
Sternula nereis nereis	Australian fairy tern	Vulnerable	Commonwealth Conservation Advice on *Sternula nereis nereis* (Fairy Tern) (TSSC, 2011)	X	Not Applicable
Migratory (Overfly Only – No impacts expected)					
Numensis madagascariensis	Eastern curlew	Critically Endangered, Migratory	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015g)	X	Not Applicable
Terrestrial Only (No Impacts Expected)					
Botaurus poiciloptilus	Australasian bittern	Endangered	-	X	Not Applicable

4.3 Conservation Values

4.3.1 Commonwealth Marine Reserves

The BMG NPP EMBA does not intersect any Commonwealth Marine Reserves (CMRs). The closest CMRs to the BMG NPP assets are:

- East Gippsland CMR located approximately 105 km east; and
- Beagle CMR located approximately 180 km south-west.

4.3.2 Victorian Marine Reserves

The BMG EMBA does not intersect any Victorian Marine National Parks or Marine Sanctuaries (refer Figure 4-2). The closest Victorian park/sanctuary to the BMG assets is:

- Beware Reef Marine Sanctuary located 55 km to the north of the BMG assets; and
- Point Hicks Marine National Park located 65 km to the north-east of the BMG assets.

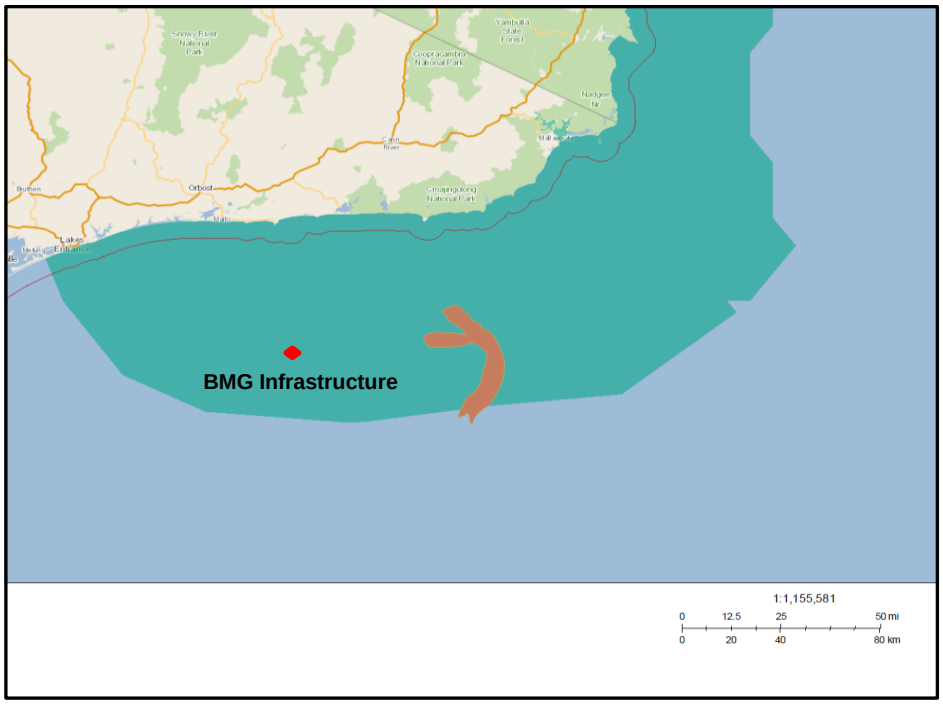
The BMG NPP EMBA does not intersect any adjacent coastlines. No terrestrial coastal or national parks are affected by NPP activities.

Figure 4-2: State Marine Reserves and Coastal Parks (Parks Victoria, 2003)

4.3.3 Key Ecological Features (KEFs)

The BMG assets are located within the 'upwelling east of Eden' KEF and are located approximately 60 km west of the Big Horseshoe KEF. Both areas are recognised for high productivity and aggregations of marine life (CoA, 2015) (refer Figure 4-3).

Figure 4-3: Key Ecological Features in proximity to BMG (DoEE, 2017a)



4.3.3.1 *Upwelling East of Eden*

The 'Upwelling east of Eden' KEF is associated with the dynamic eddies of the EAC which cause episodic productivity events when the EAC interacts with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms that are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish (CoA, 2015).

The upwelling supports regionally high primary productivity in turn supporting fisheries and biodiversity, including top order predators, marine mammals and seabirds. This area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form. The area is also important for seals, other cetaceans, sharks and seabirds (CoA, 2015). This feature displays seasonal and annual variation (CoA, 2015).

4.3.3.2 *Big Horseshoe*

The Big Horseshoe Canyon is the easternmost arm of the Bass Canyon systems and its steep, rocky slopes provide hard substrate habitat for attached large megafauna. Sponges and other habitat forming species provide structural refuges for benthic fishes, including the commercially important pink ling. It is the only known temperate location of the stalked crinoid *Metacrinus cyaneu* (CoA, 2015).

This KEF lies outside the BMG NPP EMBA.

4.3.4 Matters of National Environmental Significance

The following assessment has been made for Matters of National Environmental Significance:

- *World Heritage Properties*: No world heritage areas are listed within the BMG NPP EMBA (DoEE, 2017b). The only World Heritage area within the south-east marine region is Macquarie Island located approximately 2000 km to the south of the BMG assets (CoA, 2015);

- *National Heritage Places*: No National Heritage Places are listed within the BMG NPP EMBA (DoEE, 2017b). The closest marine-based National Heritage Place is Lord Howe Island located approximately 1200 km to the north-east;
- *Commonwealth Heritage Places:* Gabo Island Lighthouse, located approximately 130 km northeast of the BMG assets is the closest listed Commonwealth heritage place (DoEE, 2017b). This does not lie in the BNG NPP EMBA;
- *Wetlands of International Importance*: The nearest wetland of international significance to the BMG NPP EMBAs is the Gippsland Lakes RAMSAR site located on the coast of Ninety Mile Beach (DoEE, 2017b). This is approximately 80 km northwest of the BMG assets. This RAMSAR site does not lie within the BMG NPP EMBA.
- *Threatened Ecological Communities*: There are no listed threatened ecological communities within the BMG NPP EMBA (DoEE, 2017b).

4.4 Cultural Heritage

4.4.1 Historic Shipwrecks

The National Shipwreck and Relic database (DoEE, 2017c) identified three historic shipwrecks at Port Albert (Blackbird [1878], PS Clonmel [1841] and PS Thistle [1859]) located 170 km southwest from the BMG assets and one shipwreck (SS Glenelg [1900]) near Lakes Entrance, 80 km from the BMG assets. These historic shipwrecks are not coincident with the BMG NPP EMBA.

4.4.2 Aboriginal Heritage

The Gippsland coastline is of significance with respect to aboriginal cultural. This includes areas where there may be no physical evidence of past cultural activities but includes places of spiritual or ceremonial significance, places where traditional plant or mineral resources occur or trade and travel routes (DCPD, 2008). These places are often found near major food sources such as rivers, lakes, swamps and the coast (DEPI, 2014).

The BMG NPP EMBA does not intersect with adjacent shorelines. No impact to aboriginal cultural heritage is expected from NPP activities.

4.5 Socio-economic Environment

4.5.1 Commercial Shipping

The South-east marine region carries significant shipping activity and shipping volumes. This includes international and coastal cargo trade, passenger services and cargo and vehicular ferry services across Bass Strait from the major ports of Melbourne, Geelong and Western Port. Other minor ports important to commercial and recreational fishing, yachts and other pleasure craft are Lakes Entrance (Victoria) and Eden (NSW) (CoA, 2015).

An ‘Area to be Avoided’ shipping exclusion zone exists around the operating oil and gas platforms in the Gippsland Basin, whereby unauthorised vessels larger than 200 gross tonnes are excluded from entry. This ‘Area to be Avoided’ is located immediately west of the BMG assets.

The BMG assets lie approximately 8.5 km west of areas of high density shipping traffic

4.5.2 Commercial Fishing

Table 4-2 provides a summary of the Commonwealth and Victorian commercial fisheries which may operate in the BMG NPP EMBA.

Table 4-2: Commercial Fisheries operating in the BMG NPP EMBA

Fishery	Target Species	Fishing intersection with NPP Assets?	Does Fishing intersect with EMBA?	Fishing Method and Permits/Licences	Fishing Management Area Location	Comments
COMMONWEALTH FISHERIES						
Bass Strait Central Zone Scallop Fishery	Scallops (*Pecten fumatus*).	**No.** Operates from 20nm from shoreline.	**Yes**	Towed dredge fishing method. Fishery managed via seasonal/area closures and total allowable catch (TAC) controls together with quota statutory fishing rights (65 permits) and individual transferrable quotas. 11 vessels were active in the fishery in 2015.	20 - 200 nm from the coast of Victoria and Tasmania	Scallop spawning occurs from winter to spring (June to November); the timing is dependent on environmental conditions such as wind and water temperature (Sause *et al*., 1987). Fishery can operate down to 120m water depth. Value of Fishery: $2.8M (2015)
Eastern Tuna and Billfish Fishery	Albacore tuna (*Thunnus alulunga*) Bigeye tuna (*Thunnus obesus*) Yellowfin tuna (*Thunnus albacares*) Broadbill swordfish (*Xiphias gladius*) Striped marlin (*Tetrapturus audux*).	**No.** Fishery effort is concentrated along the NSW coast and southern Queensland coast (2015 data). No Victorian ports are used to land catches.	**No.**	Pelagic longline, minor line (such as handline, troll, rod and reel). A total of 90 boat Statutory Fishing Rights, and 101 minor line Statutory Fishing Rights were issued in 2015. Vessels operating – 39 longline and 2 minor-line.	South Australia/Victoria border, around east coast of Australia to Cape York, including waters around Tasmania within the Exclusive Economic Zone (EEZ).	Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012). Value of Fishery: $35M (2015)
Skipjack Tuna Fishery (Eastern)	Skipjack tuna (*Katsuwonus pelamis)*	**No.** No fishing effort since 2008-9 fishing season (stock highly variable and Australia is at the edge of the species range).	**No.**	Historically, over 98% of the catch was taken using purse seine catch method. Pole and line method was used for the remaining 2% of the catch. Currently 18 fishing permits (2014-15) but no active Australian vessels.	Extends from the border of Victoria and South Australia to Cape York, Queensland.	Skipjack tend to congregate at convergences, boundaries between cold and warm water masses and spawn in spring (Food and Agriculture Organization of the United Nations, 2012). Coastal areas managed by the States rather than Commonwealth.
Small Pelagic Fishery	Jack mackerel (*Trachurus declivis, T. symmetricus, T. murphyi*) Blue mackerel (*Scomber australasicus*), Redbait (*Emmelichthys*	**No.** Fishery effort concentrated in the near-shore GAB (west of Port Lincoln and kangaroo Island)	**No.**	Purse seine and mid-water trawl are the main fishing methods. There were 32 Statutory Fishing Rights in the 2015-16 fishing season, with 2	The fishery extends from southern Queensland to Western Australia to the edge of the Australian Fishing Zone (AFZ) (200 nm).	The Eastern Small Pelagic Fishery is limited entry, with total allowable catch limits and gear restrictions. Value of Fishery: Not released (confidential) (2014-5)

Fishery	Target Species	Fishing intersection with NPP Assets?	Does Fishing intersect with EMBA?	Fishing Method and Permits/Licences	Fishing Management Area Location	Comments
	nitidus) and Australian sardine (*Sardinops sagax).*	and Western Victoria. Eastern sub-area effort is concentrated in far southern NSW and Tasmania (2015-16 data).		purse seine and 1 mid-water trawl vessels active.		
SESSF – CTS & Danish Seine	Blue grenadier (Macruronus novaezelandiae), tiger flathead (Platycephalus richardsoni), pink ling (Genypterus blacodes) silver warehou (Seriolella punctata).	**Yes** Trawl sector is concentrated around shelf-break areas. Danish seine activity is located on the continental shelf and operate in sandy bottom environments.	**Yes**	Fishing methods include otter trawl and Danish seine. There are 57 trawl licences with 38 trawl and 16 Danish seine vessels operational in the 2015/16 season.	CTS: Covers the area of the AFZ extending southward from Barrenjoey Point (north of Sydney) around the New South Wales, Victorian and Tasmanian coastlines to Cape Jervis in South Australia to the limit of the AFZ. No access by otter board trawlers in State waters.	The SESSF is a limited entry fishery. Other management arrangements include trip, incidental catch and size limits, prohibited take, gear restrictions and spatial and temporal closures. Major Danish seine port is Lakes Entrance (where majority of fleet is located) Value of Fishery: $37.7M (2014-5)
SESSF - GHATS	Elephantfish (*Callorhinchus milii*) Gummy shark (*Mustelus antarcticus*) Sawshark (*Pristiophorus cirratus*, *P. nudipinnis*)	**Yes (Gillnet)** Gillnet sector heavily utilises the continental shelf. Hook sector does not fish in the Gippsland Basin.	**Yes (Gillnet)**	Within the Shark Gillnet and Hook sector there were 61 gillnet fishing permits and 13 hook fishing permits issued in 2015-16 season. Vessels actively fishing during the season included 37 gillnet vessels and 24 hook vessels.	Shark Gillnet and Hook sector extends for the Victorian-NSW border around Tasmania to the SA-WA border and includes waters to the edge of the AFZ. Sector is not permitted to fish within Victorian state waters.	Value of Fishery: $16.9M (2014-15)
Southern Bluefin Tuna Fishery	Southern bluefin tuna (*Thunnus maccoyii*).	**No.** Fishery effort concentrated in the Great Australian Bight (GAB) off Kangaroo Island and in southern NSW coast off the continental shelf (2015 data).	**No.**	The primary fishing method is purse seine in waters off South Australia with a number of fish captured by longline vessels off the East Coast. Tuna caught in SA are then transferred to aquaculture farming pens off Port Lincoln in South Australia. In the 2014-15 fishing season, there were 89 Statutory Fishing Rights with 6 active purse seine	The fishery extends throughout all waters in the AFZ.	Southern Bluefin Tuna spawn in the north-east Indian Ocean. Spawning occurs from Spring to Autumn after which juveniles are thought to migrate south. Young tuna surface in the GAB between November and April. Value of Fishery: $36.8M (2014-5)

Fishery	Target Species	Fishing intersection with NPP Assets?	Does Fishing intersect with EMBA?	Fishing Method and Permits/Licences	Fishing Management Area Location	Comments
				vessels and 18 longline vessels.		
Southern Squid Jig Fishery	Arrow squid (*Nototodarus gouldi*).	**No.** Data indicates that fishing is concentrated south of Portland and Warrnambool. Commonwealth fishery does not operate in Victorian State waters.	**No**	Squid jigging is the fishing method used, mainly in water depths of 60 to 120 m, at night. In 2015, there were 7 active jig vessels in the Commonwealth fishery. Portland is a primary landing port.	The fishery extends from the SA/WA border east to southern Queensland to the edge of the AFZ.	Fishing is seasonal with the season starting in February and ending in June. The season starts off the Port Phillip Bay heads and slowly moves westwards to Portland as the season progresses, following the natural migration of the squid (SIV, 2016). Most of the jig catch is taken between January and June each year, with the highest catches concentrated in March and April. Value of Fishery: $2.3M (2015)
VICTORIAN FISHERIES						
Rock Lobster Fishery	Predominantly southern rock lobster (*Jasus edwardsii*), along with small quantities of eastern rock lobster (*Jasus verreauxi).*	**No.**	**Yes.**	47 licences in the eastern zone, permitted to use baited rock lobster pots. In 2014/15, 59 tonnes were harvested in the eastern zone. Fished from rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep. Pots are generally set and retrieved each day, marked with a surface buoy. Catch data for the eastern zone indicates fishing occurs year-round, with catches being much reduced during April, May, June & July, and highest catches occurring from December and January.	Assets covered by Eastern Zone include Apollo Bay to the Victorian-NSW border border).	Larvae hatching occurs between September and November. Fishing is prohibited from 15 September to 15 November for male rock lobsters, and from 1 June to 15 November for female rock lobsters. Value of Fishery: $15M (2015) (SIV, 2017)
Giant Crab Fishery	Giant crab (*Pseudocarcinus gigas*).	**No** Fishery is located in the Western Zone (Apollo Bay to SA-	**No**	Giant crabs can only be taken using commercial rock lobster pots by Western Zone lobster fishers.	Assets covered by Western Zone (Apollo Bay to the SA/Vic border) and south to 40ºS.	The closed season for female and male giant crabs is from 1 June until 15 November and from 15 September to 15 November, respectively. There is a total year

Fishery	Target Species	Fishing intersection with NPP Assets?	Does Fishing intersect with EMBA?	Fishing Method and Permits/Licences	Fishing Management Area Location	Comments
		Victorian border)		In 2016 there were 33 licenses within the fishery (SIV, 2017). Fished mostly on the shelf break (150-350 m water depth).		round prohibition on the retention of berried females. Value of Fishery: $0.6M (2015)

References: ABARES (2016) and Agriculture Victoria (2017) unless otherwise quoted.

4.5.3 Recreational Fishing

Recreational fishing and boating is largely confined to nearshore coastal waters. As the Bass Strait is relatively shallow, the water currents through the Bass Strait can create unpredictable seas, reducing the numbers of recreational boats from venturing long distances into the Bass Strait from shore. Typically, recreational fishing targets snapper, King George whiting, flathead, bream, sharks, tuna, calamari, and Australian salmon (DPI, 2012). Recreational fishing activity is not expected at the BMG assets.

4.5.4 Petroleum Exploration, Production and Carbon Capture and Storage

The Gippsland Basin has 13 exploration permit areas and 25 current offshore production licenses. A total of 23 offshore platforms have been installed in Bass Strait since first production was established (excluding subsea production wells). Petroleum production has centred on the Esso Australia Resources Pty Ltd offshore facilities consisting of 23 offshore platforms, subsea developments and 880 km of associated pipelines tied back to the Gippsland Gas Plant.

Other hydrocarbon facilities in the Gippsland Basin include:

- Longtom Gas Development developed by Nexus Energy Pty Ltd (now SGH Energy) from 2009-2015. A pipeline connected the Longtom wells to the Patricia Baleen gas pipeline, feeding into the Orbost Gas Plant.
- Patricia-Baleen Gas Development mothballed in 2015 by Santos (now owned by Cooper Energy), produced gas to the Orbost Gas Plant. These facilities are currently in ‘care and maintenance’ mode.
- Tasmanian Gas Pipeline operated by Alinta Energy which transports natural gas from Victoria (Seaspray) to Tasmania (Five Mile Bluff) (CoA, 2015).

Cooper is developing the Sole field located 36 km from the Gippsland coast. This includes drilling at least one development well and installation of a 65 km offshore pipeline to the Orbost Gas Plant where sole gas will be treated to sales quality gas. The Sole gas field has 241 PJ of gas (2C Contingent Resource) and will be produced at 25 PJ/annum. It is expected to have a field life of approx. 10 years to (2029) with first gas expected in March 2019 (COE, 2016).

The BMG assets are not located in, or in proximity to, any areas covered by Greenhouse Gas Permits.

4.5.5 Defence Activities

Defence uses offshore areas for training operations including live firing, bombing practice from aircraft, air-to-air and air-to-sea or ground firing, anti-aircraft firing, firing from shore batteries or ships, remote controlled craft firing, and rocket and guided weapons firing. The BMG assets are not located in proximity to defence training areas with the nearest facility located more than 400 km to the north-east at Jervis Bay (NSW) (CoA, 2015).

Mine fields were laid in Australian waters during World War II. Post-war minefields were swept to remove mines and to make marine waters safe for maritime activities. There are three areas identified as dangerous due to unexploded ordinances (UXO), though these are located south and east of Wilson’s Promontory (~210 km southwest of BMG assets).

4.5.6 Submarine Cables

Submarine cables located in Bass Strait are limited to the subsea floor between Tasmania and the Australian mainland. This includes two Telstra fibre optic cables as well as Basslink, a subsea interconnector, completed in 2006 which joins the Tasmanian and national electricity grid. These assets are not located in proximity to the BMG NPP assets (Huawei Marine Networks, 2017).

5 Environmental Impact and Risk Assessment Methodology

5.1 General

5.1.1 Method

The methodology adopted for determining environmental impacts and risks associated with BMG NPP activities is consistent with the approach outlined in ISO 14001 (Environmental Management Systems), ISO 31000:2009 (Risk Management) and HB203:2012 (Environmental Risk Management – Principles and Process). Figure 5-1 provides the process adopted for managing impacts and risks associated with the petroleum activity.

Figure 5-1: Impact and Risk Management Methodology

For the BMG NPP activity, environmental hazards and their associated impacts or risks have been identified and assessed undertaking the following steps:

- Defining the activity and associated environmental hazards (routine and non-routine (emergency) activities);
- Identifying the environmental and social values at risk within, and adjacent to, the petroleum activity area;
- Establishing the credible environmental impact of the hazard to receptors and determining the maximum credible impact for each hazard associated with the activity (i.e. inherent impact);
- For environmental hazards with the potential to impact the environment during the activity, identifying the likelihood of occurrence of the impact;
- Identifying control measures to eliminate or reduce the level of impact and/or the likelihood of the impact occurring; and

Assigning a level of residual impact or risk (after control measures are implemented) utilizing Upstream PS's qualitative risk matrix (refer Table 5-1 [Consequence Definition], Table 5-2 [Likelihood Definition], Table 5-3 [Qualitative Risk Matrix] and Table 5-4 [Management of Impact & Risk]). In accordance with the Upstream PS/Cooper acceptance criteria, the impacts and risks continue to be reassessed until it is demonstrated the impact or risk is reduced to a level which is as low as reasonably practicable (ALARP) and is acceptable according to Upstream PS/Cooper's acceptance criteria.

For the BMG asset, environmental hazard identification and assessment considered the following:

- Activities occurring during NPP and typical equipment/vessels to be utilized in those activities;
- The environmental sensitivity of the receiving environment with respect to species distribution, subsea habitat types and location of environmentally sensitive areas (i.e., BIAs, conservation areas, etc.) undertaken as part of literature reviews; and
- Feedback from marine stakeholders to understand socio-economic activities that may conflict with NPP activities during consultation.

Within this context, a listing of credible activity-related environmental hazards and possible impacts were identified for the NPP activities.

Table 5-1: Definition of Consequence

Consequence (C)	Injury/ Health effect	Regulatory	Environmental impact	Asset Production Loss	Business Reputation
Catastrophic	2 or more fatalities OR severe irreversible illness / disability to more than 10 persons.	Civil / criminal prosecution OR potential jail terms for directors or fines for company OR Loss of operating licenses.	Extremely severe environmental impact with significant recovery work over a few years or Global media interest.	Extreme > $5M	Extreme adverse public, political or media outcry, resulting in international coverage. Critical impact on business reputation & future.
Severe	1 fatality OR serious irreversible illness / disability (>30%) to less than 10 persons.	Civil prosecution OR unfavourable tariff outcomes.	Major environmental impact with significant site impact and recovery work over a few months. Regional / national media interest.	Severe $ 2.5M to < $5M	Major adverse national media /public / political attention.
Major	Serious permanent disability / illness (<30%) to 1 person.	Unfavourable policy outcomes OR systemic breaches (small and large). Enforceable undertakings.	Significant environmental impact with off-site impact and recovery work over a few weeks. Some local and regional media interest.	Major $1M to < $2.5M	Significant impact on business reputation and/or national media exposure.
Serious	Serious injury or serious health effects resulting in more than 5 days lost time OR more than 1 month alternate / restricted duties.	Systemic minor PIN or regulatory breaches OR 1 large breach OR no formal conviction.	Serious environmental impact with some on-site impact and recovery work over a few days. Some local media interest.	Serious $300k to < $1M	Serious, adverse local public or media attention or complaints.
Moderate	Injury / health effect to individual requiring medical treatment by a medically qualified person with less than 5 days lost time OR less than 1 month alternate / restricted duties.	Local investigation OR on the spot fine OR Prohibition Improvement Notice(PIN).	Minor environmental impact, slight or negligible impact, negligible remedial / recovery work.	Moderate $30k to < $300k	Minor impact. Public awareness, but no public concern.
Minor	Injury or illness requiring first aid (no lost time or alternate / restricted duties).	Minor regulatory breach OR compulsory reporting of incident.	Negligible environmental impact, effect contained locally.	$0k to < $30k	Negligible impact on reputation.

Table 5-2: Definition of Likelihood

Descriptor	Exposure	Frequency
A. Extremely Unlikely	Less than once per 100 years	Not known to occur in a comparable activity internationally but plausible (less than 1%)
B. Very Unlikely	Between once per 100 years and once per 10 years	Known to occur in a comparable activity internationally but unlikely (1-5%)
C. Unlikely	Between once per 10 years and once per year	Has occurred or could occur in a comparable activity in Australia (5-14%)
D. Likely	At least every three months	Has occurred once or twice in the Company (15-49%)
E. Very Likely	At least once per month	Has occurred frequently in the Company (50-90%)
F. Almost Certain	At least once per week	Has occurred frequently at the facility (greater than 90%)

Table 5-3: Upstream PS Qualitative Risk Matrix

Table 1: Risk Matrix

	A	B	C	D	E	F
6	High	High	Very High	Very High	Extreme	Extreme
5	Med	High	High	Very High	Very High	Extreme
4	Med	Med	High	High	Very High	Very High
3	Low	Med	Med	High	High	Very High
2	Low	Low	Med	Med	High	High
1	Low	Low	Low	Med	Med	High

Consequence (C)

Likelihood (L)

Risk **(R)** = Likelihood **(L)** x Consequence **(C)**

Table 5-4: Management of Impact and Risk Determinations

Step 2	Residual Risk Rating		
Risk Ranking	Management Action Required and Authorities		
		Reporting requirements	Acceptance Authority
Extreme	If Risk is related to Health, Safety or Environmental issues then immediate reduction action (including consideration of the immediate cessation of the activity) is to be undertaken. If the risk is to be accepted temporarily then approval from the CEO must be obtained and the Board should be consulted. Managed by the GM's and monitored by the Executive Management Team (EMT), Risk Committee (RC) and the board.	ASAP to MD	Managing Director (MD)
Very High	Take action to reduce residual risk to lower level by a Risk Treatment Plan to be developed as soon as possible and managed by General Manager and monitored by EGM.	ASAP to RM Monthly to MD for Review	Managing Director (MD)
High	Risk Treatment Plan to be developed as soon as reasonably practicable when risk reduction is possible by additional controls. Plan to deal with in keeping with the business plan. Managed by Asset/Project Manager and monitored by General Manager	Monthly Report to RM	Regional Manager
Medium	Risk Treatment Plan implemented in keeping with other priorities. Safety and Health related consequences prioritised accordingly Managed and monitored by Asset Managers	Monthly Report to RM	Project/ Operations Manager
Low	No Risk Treatment Plan required. Attention from management required specifically for Safety and Health consequences Managed and monitored by BU Supervisors/Team Leader. Any actions managed through action tracking system KPI's	Project/ Operations Manager	P.I.C. Supervisor

The following definitions for impact and risk are adopted in this assessment methodology:

- **Impacts** result from activities that by their nature do result in a change to the environment or a component of the environment, whether adverse or beneficial. Impacts can occur as a result of a routine or non-routine event. For example, there will be underwater sound emissions with associated impacts as a result of vessel activity.
- **Risks** result from activities where a change to the environment or component of the environment may occur as a result of the activity (i.e., there *may* be consequences *if* the incident event actually occurs). Risk is a combination of the *consequence* of an event and the associated *likelihood* of its occurrence. For example, a hydrocarbon spill may occur if a vessel's fuel tank is punctured by a collision incident during activities. The risk of this event is determined by assessing the consequence of the impact (using factors such as the type and volume of fuel and the nature of the receiving environment) and the likelihood of this event happening (which may be determined qualitatively or quantitatively).

5.1.2 Selection of Control Measures

For each identified impact and risk, control measures are identified to reduce the impact or risk. The hierarchy of controls framework has been used to identify controls that are effective (refer Figure 5-2) within assessment activities.

Multiple controls selected from this hierarchy provide a depth (number) and breadth (control type) to prevent an impact or risk from occurring. Control types listed in the upper section of the hierarchy are recognised as being more effective in terms of functionality, availability, reliability, survivability, independence and compatibility given their inherent design characteristics.

Figure 5-2: Hierarchy of Controls

Control Type	Effectiveness	Examples
Eliminate		*Eliminate the impact or risk.* Hydraulic lines are replaced with electrical umbilicals.
Substitute		*Change or substitute the impact or risk for a lower one.* Chemicals selected are OCNS 'Gold' or 'Silver' compared with 'Purple'
Engineer		*Engineer out the impact or risk* For seismic use solid streamers rather than fluid-filled.
Isolate		*Isolate the environment from the impact or risk* No anchoring within sensitive areas.
Administrative		*Provide instructions or training to people to lower impact or risk* At-sea refuelling procedures or pre-work Job Hazard Analyses (JHA).

5.2 ALARP Criteria

The ALARP model adopted for this assessment is dependent upon the:

(a) Residual impact or risk level (provided in Figure 5-3). For higher level impact and risk residuals ALARP assessments consider options for alternative (replacement) controls; additional controls to reduce the environmental impact/risk; and improvements to already adopted controls to increase their effectiveness.

Uncertainty in impact/risk (shown diagrammatically in

(b) Figure 5-4). This framework has been adapted from Guidance on Risk-related Decision Making (Oil and Gas UK, 2014) where there is a level of uncertainty or novelty associated with the impact or risk (referred to as Decision Type A, B. or C). This decision type is selected based upon an informed decision around the uncertainty of the risk. Decision types and methodologies to establish ALARP are outlined in Table 5-5.

Figure 5-3: ALARP Determination for Impact & Risk

IMPACT	MINOR	MODERATE	SERIOUS	MAJOR	SEVERE	CATASTROPHIC
	Broadly acceptable	Tolerable if ALARP				Intolerable
RISK	LOW	MEDIUM/HIGH				VERY HIGH/EXTREME
	Broadly acceptable	Tolerable if ALARP				Intolerable

Figure 5-4: Impact and Risk 'Uncertainty' Decision Making Framework

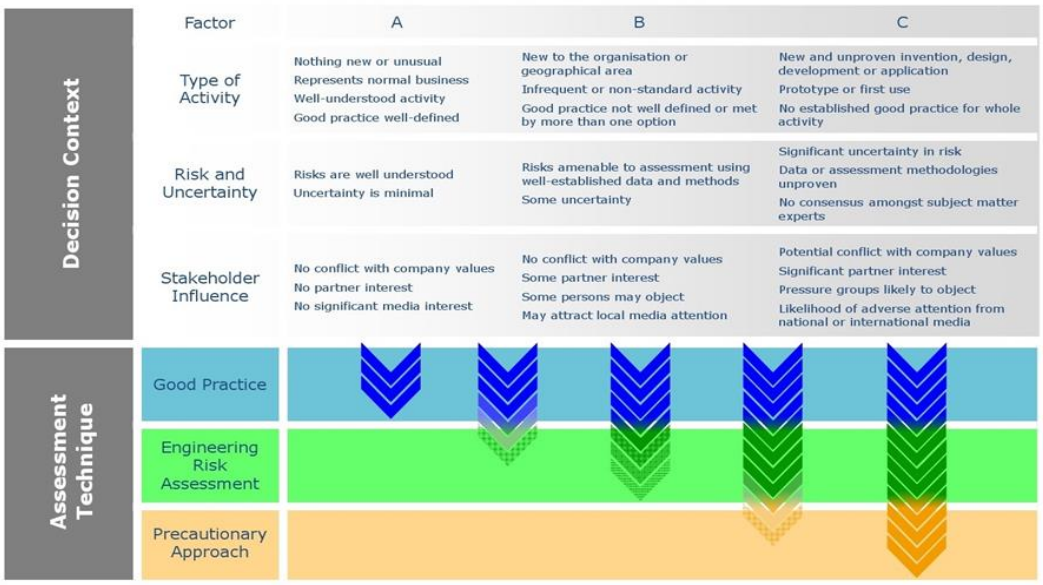


Table 5-5: ALARP decision-making based upon level of uncertainty

Decision type	Description	Decision-making tools
A	Risks classified as a Decision Type A are well-understood and established practice.	**Legislation, codes and standards:** Identifies the requirements of legislation, codes and standards that are to be complied with for the activity. **Good Industry Practice**: Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards. **Professional Judgement**: Uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks, is applied.
B	Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns. These risks may deviate from established practice or have some life-cycle implications and therefore require further analysis using the following tools in addition to those described for a Decision Type A.	**Risk-based tools such as cost based analysis or modelling:** Assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process. **Company values:** Identifies values identified in Upstream PS/Cooper's HSEC Policies.
C	Risks classified as a Decision Type C will typically have significant risks related to environmental performance. The risks may result in significant environmental impact; significant project risk/ exposure; or may elicit strong stakeholder awareness and negative perception. For these risks, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and	**Societal Values:** Identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder concerns as gathered through consultation.

Decision type	Description	Decision-making tools
	external stakeholder consultation as part of the risk assessment process.	

5.3 Acceptability Criteria

Cooper considers a range of factors when evaluating the acceptability of environmental impacts or risks associated with its activities. This evaluation works at several levels as outlined in Table 5-6.

Table 5-6: Cooper Acceptability Criteria

Test	Question	Acceptability demonstrated
Policy compliance	Is the proposed management of the risk or impact aligned with Cooper's HSEC Policy?	The impact or risk must be compliant with the objectives of the company's policies.
Management System Compliance	Is the proposed management of the impact or risk aligned with the HSEC Management System?	Where specific procedures and work instructions are in place for management of the impact and risk in question, acceptability is demonstrated.
Commonwealth and State legislative criteria	Is the impact or risk or impact being managed in accordance with existing Australian, State and/or international laws or standards?	Compliance with specific laws or standards is demonstrated.
Stakeholder Expectations	Have stakeholders raised any objections or claims about adverse impacts associated with the activity, and if so, have merits of the objection been assessed? For those objections and claims with merit, have measures been put in place to manage those concerns?	Stakeholder concerns must have been adequately responded to and closed out.
Environmental context	Is the impact or risk being managed pursuant to the nature of the receiving environment (e.g., sensitive or unique environmental features generally require more controls to protect them than environments widely represented in a region)? Have applicable objectives and actions within marine reserve management plans, species recovery plans, threat abatements plans or conservation advices plans been addressed?	The proposed impact or risk controls, performance outcomes and performance standards must be consistent with the nature of the receiving environment. Compliance with objectives and actions contained in relevant plans.
Environmentally Sustainable Development (ESD) Principles	Does the proposed risk/impact comply with the APPEA Principles of Conduct (APPEA, 2008), requiring integration of ESD principles into company decision-making, and Government policy frameworks that integrate ESD principles into implementation strategies?	The overall operations are consistent with the APPEA Principles of Conduct and Commonwealth environmental strategy documents.
Environmental impact & risk (ALARP)	Is there any further reasonable and practicable controls that can be implemented to further reduce the impact or risk?	There is a consensus within Cooper that residual impact or risk has been demonstrated to ALARP.

6 Environmental Assessment

A summary of impact and risk assessment outcomes for the BMG NPP is detailed in Table 6-1. The residual impact or risk is based upon the control measures identified and implemented as detailed in each of the hazard sections within this section.

Table 6-1: BMG NPP Environmental Impact and Risk Assessment Summary

#	Environmental Impact or Risk	Residual Impact or Risk Ranking
NPP Impacts		
1	Seabed Disturbance	MINOR
2	Cooling water & brine discharges (Vessel)	MINOR
3	Light Emissions (Vessel)	MINOR
4	Noise Emissions (Vessel)	MODERATE
5	Treated Bilge Discharges (Vessel)	MINOR
6	Treated Sewage/Grey Water Discharges (Vessel)	MINOR
7	Food-scrap Discharges (Vessel)	MINOR
8	Air Emissions (Vessel)	MINOR
NPP Risks		
1	Introduction of Invasive Marine Species	MEDIUM
2	Disruption to Commercial Shipping & Fishing	LOW
3	Injury to megafauna (vessel strike)	LOW
4	Waste overboard incident	LOW
5	Equipment loss to the Environment	LOW
6	Spills: Minor – Vessel, ROV, IMR Activities	LOW
7	Spills: Infrastructure (Condensate)	LOW
8	Spills: Vessel Collision (Marine Diesel)	LOW

6.1 Impact: Seabed Disturbance

6.1.1 Hazard

The following NPP activities have the potential to disturb the seabed:

- Erosion or sediment build-up around seabed infrastructure;
- Temporary ‘wet parking’ of equipment on seabed during IMR activities;
- Sandbag or mattress installation over minor equipment items (EFLs/HFLs) which become unstable;
- Vessel anchoring during IMR activities (contingent activity); and
- Marine growth removal.

Note only sections of infrastructure with encrusting organisms which make maintenance and inspection activities difficult (e.g. access to anodes) will have marine growth removed. This will occur on an infrequent basis.

6.1.2 Known and Potential Impacts

The known and potential impacts of these environmental hazards are:

- Localised disturbance or loss or benthic habitat;

- Localised turbidity of the near seabed water column;
- Seabed infrastructure acting as artificial habitat.

6.1.3 Evaluation of Environmental Impact

6.1.3.1 Seabed Disturbance, Loss of benthic habitat/artificial habitat

The BMG subsea infrastructure, which is partially trenched, has the potential to act as a water obstruction and could cause localised alterations to the hydrodynamic regime directly around infrastructure, such as localised scouring/erosion or deposition of sediment which leads to a build-up against infrastructure over time. This will result is a localised impact to benthic habitat which is not of conservation significance (Consequence 1 (minor)).

The subsea infrastructure also acts as a habitat, providing a localised artificial environment for marine organisms to colonise. Given the small footprint of this infrastructure alteration to benthic habitat is not considered significant (Consequence 1 (minor)).

Placement of objects on the seabed such as vessel anchors, temporary placement of ROVs and sand bags/mattresses can also cause a localised disturbance or loss of benthic habitat. It is noted that the benthic habitat present at the BMG infrastructure is not significant ecologically with the habitat type widespread within Bass Strait. Additionally, given the dynamic nature of Bass Strait, seabed disturbance (e.g. anchor depressions) will be rapid recolonised by adjacent benthic species given the high energy environment (Consequence 1). *Note vessel anchoring is included as a contingency (only) within this EP as the IMR vessel usually has station–keeping or dynamic positioning capability.*

6.1.3.2 Turbidity of near seabed water column

Minor localised and temporary turbidity may occur from the placement of objects on the seabed (e.g. sandbag installation) or via marine growth removal (e.g. anode replacement).

As part of ongoing maintenance and to facilitate inspections, the removal of marine growth from infrastructure by an ROV may be required. This is expected to be limited to minor works on flowlines, BAM, etc. Marine growth may be removed with high-pressure water blasting or brushing or a combination of the two.

- Water jetting – typically conducted by ROV, water will be pressurized to above hydrostatic pressure. Generally water jetting activities shall be through small diameter water jets that act locally on the pipe/structure. Wash out or induced currents are typically not experienced during this activity due to the nature of the operation; or
- Brushing – typically a coarse brush would be applied to the pipeline or structure on a localized area only, this is less common.

Marine growth removal may result in a localised increase in water column turbidity, due to the suspended marine growth. This is unlikely to affect benthic productivity around the BMG assets due to the short period over which marine growth removal will be conducted at any location (less than 1 day) and the lack of sensitive benthic habitats in the immediate vicinity of the infrastructure. This minor increase in water column turbidity is in the context of Bass Strait, a dynamic environment where there are significant levels of sediment movement which biota accommodates. Impacts associated with this activity are localised, temporary and recoverable not affecting any recognised conservation values (Consequence 1 (minor)).

6.1.4 Environmental Impact and Control Measure Summary

Aspect:	Seabed Disturbance: IMR activities impacting on the seabed
Impact summary:	Disturbance to seabed habitat and reduced water quality.
Extent of impact:	Localized (immediately around infrastructure or work area).
Duration of impact:	Seabed (short-term and long-term [placement of sand bags]) Reduced water quality (temporary ~ minutes)
Level of Certainty of Impact:	**HIGH:** Activity is well understood and seabed sensitivities within the BMG PSZ are known.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and prevent disturbance to the seabed during IMR activities are:

- *Contractor (Vessel) Selection*: The Upstream PS Contractor HSEQ Evaluation process ensures the vessel selected for IMR activities has Dynamic Positioning (DP) or station-keeping capability;
- *Anchoring*: Anchoring is only permitted in an emergency or when DP or station-keeping is not practicable;
- *Sandbags*: Sandbags deployed on equipment will contain beach sand;
- *Equipment Deployment/Retrieval*: ROV activities are undertaken by qualified and competent personnel;
- *IMR Activity Risk Assessment:* A campaign-specific IMR activity risk assessment is undertaken to ensure all environmental impacts are identified, assessed and controls identified. Controls are then incorporated into work-packs prior to offshore works commencing;
- *Work Control Implementation:* IMR activities are controlled via a permit-to-work (PTW) which incorporates relevant controls. Requirements are reinforced at Toolbox/pre-start meetings.

6.2 Impact: Cooling water and brine discharge (vessel)

6.2.1 Hazard

Seawater: Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Seawater is drawn up from the ocean, where it is de-oxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers (in the process transferring heat from the machinery) and is then discharged to the ocean at depth (not at surface). Upon discharge, it will be warmer than the surrounding ambient water and may contain low concentrations of residual biocide if used to control biofouling.

Brine: Concentrated brine is a waste stream created through the vessels desalination equipment for potable water generation. Potable water is generated through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). Freshwater produced is then stored in tanks on board. The concentration of the brine is likely to range from 44-61 parts per thousand (ppt), which is 9-26 ppt higher than seawater (35 ppt), however this is dependent on throughput and plant efficiency.

6.2.2 Known and Potential Impacts

The known and potential environmental impact of cooling water and brine discharges are:

- Temporary and localised increase in sea water temperature causing thermal stress to marine biota; and
- Temporary and localised increase in sea surface salinity potentially causing harm to fauna unable to tolerate higher salinities.

6.2.3 Evaluation of Environmental Impact

The volume of seawater affected by a vessel's cooling water and brine discharge is expected to be within the top 10 m of the water column and within a 100 m radius of the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found that discharge water temperatures decrease rapidly as it mixes with receiving waters. The discharge water temperature fell to less than 1°C above background levels within 100 m (horizontally) of the discharge point, and within background levels 10 m vertically from the discharge point (Woodside, 2008).

Cooling waters associated with vessel discharges are expected to be smaller in magnitude than this drilling example.

Increases in sea surface salinity:

Laboratory tests undertaken to determine the tolerance threshold of organisms to stress from thermal power plant discharges identified that most tropical and temperate organisms had a common upper lethal temperature limit of about 35^{o}C. Acclimation of test organisms at 15, 20 and 25^{o}C allowed them to tolerate temperature increments of 8-9^{o}C without damage (UNEP, 1983). On this basis, impacts to marine biota from the discharge of elevated water temperatures are expected to be very localised and temporary (Consequence 1 - minor).

Increases in sea surface temperature:

The World Health Organisation (2007) identified that many marine organisms are naturally adapted to changes in seawater salinity given variances in evaporation rates from the ocean surface and land runoff/surface water discharges. Typically, the range of natural salinity fluctuation is at least ±10% of the annual ambient seawater salinity concentration. This level serves as a conservative measure of aquatic life tolerance to elevated salinity and actual salinity tolerances are usually significantly higher than this level. On this basis, impacts to marine biota from hypersaline discharges are expected to be very localised and temporary (Consequence 1 - minor).

Residual biocides and scale inhibitors:

Scale inhibitors and biocide may be used in the heat exchange and desalination process to avoid fouling of pipework. Scale inhibitors are typically low molecular weight phosphorous compounds that are water-soluble, and only have acute toxicity to marine organisms about two orders of magnitude higher than typically used in the water phase (Black *et al*., 1994). The biocides typically used in the industry are highly reactive and degrade rapidly (Black *et al*., 1994)

These chemicals 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 (Consequence 1 - minor).

6.2.4 Environmental Impact and Control Measure Summary

Aspect:	Cooling Water and Brine Discharge
Impact summary:	Elevated temperature and salinity impacts to the marine environment
Extent of impact:	Localized (~1ºC within 100m and 10m).
Duration of impact:	Short-term (duration of survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well studied and fauna sensitivities present in the BMG area are known.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure that cooling and brine water discharges are within specified operating parameters are:

- *Equipment Maintenance*: Vessel engines and associated equipment that requires cooling by water and desalination units are maintained and operate within accepted manufacturer's parameters;
- *Contractor (Chemical) Selection:* As part of contractor selection chemicals utilised as biocides or scale inhibitors will be low toxicity and meet Cooper/Upstream PS chemical performance standards for the vessel cooling and brine water systems.

6.3 Impact: Light Emissions (vessel)

6.3.1 Hazard

Light emissions will be emitted from all survey vessels on a 24 hour per day basis during survey activities from the following:

- For marine safety, vessel navigation lighting in accordance with the *Navigation Act 2012*, Marine Order Part 30 (Prevention of Collisions) will be maintained to provide clear identification to other marine users;
- Deck lighting will be provided to allow for the safe movement of personnel around the deck during hours of darkness; and
- ROV operations will utilise light underwater to illuminate the area of interest.

During the activity, the IMR vessel will generate light while in the activity area. Lighting is used for marine safety to ensure clear identification of vessels to other marine users and to allow activities to be undertaken 24 hours a day. Spot lighting may also be used on an as-needed basis, for example for a specific task such as ROV inspection, deployment and retrieval. Lighting will typically consist of bright white (i.e., metal halide, halogen, fluorescent) lights, and are not dissimilar to other offshore activities in the region, including fishing and shipping.

6.3.2 Known and Potential Impacts

The known and potential impacts of artificial lighting sources in the marine environment are:

- Light on vessels may attract light-sensitive species such as seabirds, squid and zooplankton in turn affecting predator-prey dynamics; and
- Artificial lighting may affect species during breeding periods (e.g. shearwaters, turtle hatchlings).

6.3.3 Evaluation of Environmental Impacts

6.3.3.1 Localised light glow (attractant to light-sensitive species)

High levels of marine lighting can attract and disorient seabird species resulting in species behavioural changes (e.g. circling light sources leading to exhaustion or disrupted foraging), injury or mortality in the vicinity of the light source. It is understood that bird strikes have been recorded on fishing vessels in the Southern Ocean where powerful ice lights are used in back-deck activities, however bird mortality arising from these events are generally low (Black, 2004). IMR vessels do not utilise these lights on back-deck activities with the light emitted diffuse and considered to be similar to passing commercial shipping. Given the temporary and moving nature of the light sources measurable impacts to marine bird species are not expected (Consequence 1 - minor).

Artificial light can cause significant impacts on burrow-nesting petrels and shearwaters. Fledglings often become disoriented and grounded as a result of artificial light adjacent to rookeries as they attempt to make their first flights to sea, a phenomenon known as ‘fallout’ (Birdlife International, 2012). Rodrigez at al. (2014) investigated the effects of artificial lighting from road lighting on short-tailed shearwater fledglings. The study established by removing this light source located in close proximity to nesting areas there was a decrease in grounded fledglings and a corresponding reduction in bird fatalities. BMG marine operations will operate at least 55 km from shorelines and no impacts to fledglings from vessel lighting are expected.

Other marine life may also be attracted to the IMR vessel (e.g., fish, squid and plankton) that can aggregate directly under downward facing lights. These attractant species are prey to many species of marine fauna. This is a technique used by squid jig fishermen, who utilise powerful downward facing lights on stationary vessels, to attract and capture squid species. Fur seals have been reported as being a minor irritation to squid vessels, as they chase prey species attracted to light sources (Gales et al. 2003). As most IMR vessel lighting is directed onto deck surfaces rather than marine waters and given the movement of the vessel, any impacts arising from light emissions will be localised and temporary only (Consequence 1 - minor).

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

Underwater light from ROVs is unlikely to cause significant environmental impacts. While the ROV dives, fauna in different strata of the water column will be exposed to light for only very brief moments and then usually for a few minutes at a time near the seabed where the ROV conducts most of its work.

Given the limited duration of IMR activities any alteration to marine species foraging patterns or behavioural impacts are considered to be localised, temporary and restricted to a small proportion of the population (Consequence 1 - minor).

6.3.3.2 Attraction of light-sensitive species during breeding periods

Light pollution can be an issue along, or adjacent to, turtle nesting beaches where emerging hatchlings orient to, and head towards, the low light of the horizon unless distracted by other lights which disorient and affect their passage from the beach to the sea (EA, 2003). Given the lack of turtle nesting in Victoria, impacts to turtle hatchlings are not expected.

6.3.4 Environment Impact and Control Measure Summary

Aspect:	Vessel Lighting
Impact summary:	Light spill attracting light-sensitive species (seabirds, fish, nesting turtles) which may affect predator-prey dynamics.
Extent of impact:	Localized (immediately around vessel).
Duration of impact:	Temporary (duration of survey) and recoverable
Level of Certainty of Impact:	**HIGH:** Impacts from lighting in the marine environment have been studied and documented.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and maintain vessel lighting to a minimum which still allows for safe operation are:

- *Back Deck and Navigation Lighting:* Vessel deck and navigational lighting aligns with the following standards to prevent light spill to marine waters while ensuring safety requirements:
  - Marine Order Part 30 (Prevention of Collisions) 2016; and
  - Marine Order 59 (Offshore Support Vessel Operations) 2011.

6.4 Impact: Noise Emissions

6.4.1 Hazard

The following vessel activities have the potential to create underwater sound:

- Engine noise transmitted through the vessel hull;
- Propeller/thruster sound; and
- ROV propellers.

Shipping sound generally dominates ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). High frequency sound components rapidly dissipate with distance from the sound source with lower frequency wavelengths travelling further distances.

Vessels engaged for IMR activities will in general generate low levels of machinery noise and will be of a similar nature to other vessels operating in the region.

The sound levels and frequency characteristics of underwater noise produced by vessels are related to ship size and speed. When idle or moving between sites, vessels generally emit low-level noise. Tugboats, crew boats, supply ships, and many research vessels in the 50-100 m size class typically have broadband source levels in the 165-180 dB re 1µPa$_{RMS}$ range (Gotz *et al.*, 2009). In comparison, underwater sound levels generated by large ships can produce levels exceeding 190 dB re 1µPa$_{RMS}$ (Gotz *et al.*, 2009) and vessels up to 20 m size typically emit 151-156dB re 1µPa$_{RMS}$ (Richardson *et al.*, 1995).

McCauley (1998; McCauley and Duncan, 2001) examined the sound from a 64 m, 2,600 tonne rig tender vessel underway, which had a broadband source level of 177 dB re 1µPa @ 1m (units not specified) in approximately 110m water depth. The use of thrusters or main propellers under load produced very high levels of cavitation noise. During these activities, the measured vessel noise was broadband in nature, with the highest level measured at 137 dB re 1µPa (units not specified) at 405 m astern; levels of 120 dB re 1µPa (units not specified) recorded at 3-4 km; and the noise audible at up to 20 km against a 'natural background level' of 90 dB re 1µPa (units not specified). IMR vessels are expected to have a smaller sound footprint given the smaller size vessel.

6.4.2 Known and Potential Impacts

The primary concern arising from underwater sound generation is the potential for impacts on sound-sensitive marine fauna including:

- Attraction;
- Increased stress levels;
- Disruption to underwater acoustic cues;
- Behavioural changes;
- Localised avoidance; and
- Secondary ecological effects that may occur as a result of an effect on one (or more) species influencing another species, for example, by alteration of a predator–prey relationship.

Key sound sensitive fauna present in the area of operation are cetaceans, pinnipeds and pelagic species such as fish.

6.4.3 Evaluation of Environmental Impacts

Ambient Sounds

Physical and biological processes contribute to natural background sound including wind and waves; biological noise sources; and iceberg calving, shoaling and disintegration has recently been identified as a dominant source of low frequency (<100 Hz) noise in the Southern Ocean. Above 200 Hz, the ambient noise is mainly affected by sea state which is driven by wind speed. However between 20-200Hz, the ambient noise of the ocean is driven by the propulsion of ships (Tyack, 2008).

Ambient sound levels have been measured by BP (McCauley et al. 2012; cited in BP, 2015) in the Great Australian Bight to understand the underwater sound characteristics of the area. Sound loggers were deployed near the Head of Bight in a water depth of 50 m and two along the shelf break at water depths of approximately 200 m (in close proximity to commercial shipping areas). The following ambient sound levels were determined:

- Head of Bight: Ranged from 73.5 to 131.9 dB re 1µPa$_{RMS}$, with an average of 97.1 dB re 1µPa$_{RMS}$; and
- Shelf Break: Ranged from 74.5 to 144.9 dB re 1µPa$_{RMS}$, with an average of 111.7 dB re 1µPa$_{RMS}$.

As seen from these measurements, there is significant variance in background sound levels within the marine environment. Sound-sensitive marine fauna tolerate this level of background sound variance.

Sound Thresholds – Marine Fauna:

The criteria set by Southall et al. (2007) suggests that to cause an instantaneous injury to cetaceans (including porpoises) resulting in a permanent loss in hearing, the sound must exceed 230 dB re 1µPa (peak). The US National Marine Fisheries Service (NMFS) guidance for pulsed sound to prevent temporary thresholds shifts in hearing in marine mammals is 180 dB re 1µPa$_{RMS}$ with disturbance likely at 160 dB re 1µPa$_{RMS}$. Given the sound levels emitted by vessels, hearing impacts to cetaceans are not expected.

For non-pulsed sound, such as vessel noise, a conservative behavioural disturbance limit of 120 dB re 1µPa$_{RMS}$ is adopted for marine mammals.

There is no data on exposure or received sound levels to fish species that enable guideline thresholds to be developed. Qualitative guidelines for shipping and other continuous sound

sources, presented as sound pressure levels (SPL), provides relative risk (high, moderate, low) to fish at three distances from the source defined in relative terms as near (N), intermediate (I) and far (F) according to their specialisation (sensitivity) to sound pressure (refer Table 6-2) (Popper et al, 2014).

Table 6-2: Shipping and Continuous Sound impacts

Type of Animal	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable Injury	Temporary Threshold Shift	Masking	
Fish: no swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB re 1 μPa_{rms} (48 hrs)	158 dB re 1 μPa_{rms} (12 hrs)	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low

There is no direct evidence of mortality of potential mortal injury to fish from ship noise (Popper et al, 2014). Some evidence for auditory tissue effects or temporary threshold shifts (TTS) in hearing caused by continuous sound has been observed in goldfish (*Carassius auratus*), a species that has a swim bladder involved in hearing (primarily pressure detection). Some recoverable loss of sensory hair cells occurred in the ear after 48 hours of exposure to white noise at 170 dB re 1 μPa_{rms}. Recovery of TTS took seven days and full replacement of the sensory cells took eight days. Exposure to 158 dB re 1 μPa_{rms} in another study also resulted in TTS in goldfish and another pressure sensitive fish that hears well, the catfish *Pimelodus pictus* (32 dB TTS) (Amoser and Ladich 2003; in Popper et al, 2014). Full recovery occurred after three days for the goldfish and after fourteen days for catfish (Popper et al, 2014).

However, several species of fish lacking specializations for sound pressure detection showed no TTS in response to long term noise exposure; for example, tilapia (*Oreochromis niloticus* - Smith et al. 2004b; in Popper et al, 2014), bluegill sunfish (*Lepomis macrochirus* - Scholik and Yan 2002b; in Popper et al, 2014), and rainbow trout (Wysocki et al. 2007; in Popper et al, 2014). Rainbow trout exposed to increased noise (up to 150 dB re 1 μPa_{rms}) for nine months in an aquaculture facility showed no hearing loss or any negative effects upon the health of the fish (Wysocki et al. 2007; cited in Popper et al, 2014).

In general, increased levels of underwater noise generated by vessels supporting ROV activities, particularly from vessel (DP) thrusters, have the potential to disturb noise sensitive marine fauna present in the area.

Behavioural responses to Vessel Noise:

Studies reviewed by Richardson et al. (1995) identify the following reactions of marine fauna to vessel presence/sound:

- Sea lions (an octariid seal similar to fur seals) in water tolerate close and frequent approaches by vessels and sometimes congregate around fishing vessels. Evidence is slender and it is not known whether these animals are affected or stressed by these encounters (Peterson and Bartholomew, 1967; cited in Richardson et al, 1995).
- Dolphins tolerate or even approach vessels but can sometimes show avoidance. Reactions appear to be dependent on the dolphin's activity at the time - resting dolphins tend to avoid boats, foraging dolphins ignore them and socialising dolphins may approach

vessels (B. Wursig, pers.obs.; cited in Richardson et al, 1995). Dolphins also reduce the energy costs of travel by riding the bow and stern waves of vessels (Williams et al, 1982; cited in Richardson et al, 1995).

- Killer whales rarely showed avoidance to boats within 400 m (Duffus and Dearden, 1993; cited in Richardson et al, 1995), however further analysis has shown subtle tendencies to swim faster when multiple boats are present and a tendency to move toward less confined waters (Kruse, 1991; cited in Richardson et al, 1995).
- Sperm whales were observed to avoid out-board motored whale-watching vessels up to 2 km away with behavioural changes including altered surfacing/respiration dive patterns and more erratic surface movements (J. McGibbon, in Cawthorn 1992; cited in Richardson et al, 1995). Researchers have found that small non-motorised or sailing vessels operating non-aggressively can be used near sperm whales without disturbing them appreciably (Papastavrou et al. 1989; cited in Richardson et al, 1995).
- Baleen whales seem to ignore weak vessel sounds and move away in response to strong or rapidly changing vessel noise. Avoidance was particularly strong when vessels approached directly (Watkins, 1986; cited in Richardson et al, 1995). Vessels operating in gray whale breeding lagoons can cause short term escape reactions particularly when the vessels are moving fast and erratically, however there was little response to slow-moving/anchored vessels (Reeves 1977; Swartz and Cummings, 1978; Swartz and Jones, 1978, 1981; cited in Richardson et al. 1995). Some whales are attracted to noise from idling outboard motors and are not seriously disturbed by small vessels however calling behaviour may change to reduce masking by boat noise. During migration, gray whales were observed to change course at 200-300 m in order to move around a vessel in their path (Wyrick, 1954; cited in Richardson et al, 1995);
- Studies undertaken into Hawaiian humpbacks reaction, mostly to small vessels, identified that behaviours varied according to social groupings of whales (e.g. mothers, calves, etc.). The various effects often occurred when vessels were 500-1000 m away (Bauer, 1986; Bauer and Herman, 1986; cited in Richardson et al, 1995). Another study found when a boat approached within half a mile, humpbacks showed significant changes in the proportion of time at the surface, longer dives, altered direction (avoidance) and reduced speeds after the boat departed (M.L. Green and Green, 1990; cited in Richardson et al, 1995). A subsequent study confirmed that humpbacks often moved away when vessels were within several kilometres (Baker et al, 1982, 1883; Baker and Herman, 1989; cited in Richardson et al, 1995).
- Northern right whales appeared approachable in a slowly moving boat but moved away from vessels that approach rapidly (Watkins, 1986; Goodyear 1989; 1993; Brown et al, 1991; all cited in Richardson et al. 1995). The species was consistently silent when disturbed by boats (Watkins 1986; cited in Richardson et al, 1995). When mating or feeding they seem oblivious to the close passage of small vessels providing there was no change in course or engine speed (Goodyear 1989; Mayo and Marx, 1990; Gaskin, 1991; all cited in Richardson et al, 1995).
- Rorqual (fin, blue, minke whales) reactions to vessels have been assessed in only a few studies. In one study, results identified that rorqual whales moved away from vessels in approximately 15% of 232 vessel whale encounters. In other cases the whales remained, but most changed direction abruptly or dove to avoid the close approach by the vessel (Mitchell and Ghanime, 1982: cited in Richardson et al, 1995). Fin whales were also observed to avoid most vessels by slight changes in heading or by increasing the duration and speed of underwater travel at distances of more than 1 km (Edds and Macfarlane, 1987; cited in Richardson et al, 1995). The most marked reaction by fin and blue whales was when boats made fast erratic approaches and/or sudden changes in

speed or direction. A slow approach even in a large vessel usually caused little reaction (Edds 1988; cited in Richardson et al, 1995)

Ships (i.e., trawlers, ferries, research vessels) have also been shown to alter fish behaviour (e.g., induce avoidance, alter swimming speed and direction, and alter schooling behaviour) (Engås et al. 1995, 1998; Sarà et al. 2007; De Robertis and Handegard 2013; in Popper et al, 2014). This effect has been observed in fishing research vessels undertaking acoustic surveys for fish stock assessment. For a vessel with radiated noise levels (units not specified) of 174dB re 1µPa @ 25 Hz and 176 dB re 1µPa @ 480Hz, 200 m was a typical range observed for schooling fish to take avoidance action (Mitsen, 1993).

Additional studies into sound emitted from fishing research vessels focussed on the impacts to commercial fish species sensitive to sound (i.e., cod and herring). These species have acute directional hearing extending over a frequency range of approximately 0.1Hz to 1.2 kHz. Peak sensitivity for herring is approximately 75 dB re 1µPa (units not specified) at approximately 20 Hz and 1.2 kHz. For cod a similar sensitivity applies from 100-300 Hz (Mitsen, 1995). Reaction to vessel sound observed included increased swimming speeds and lateral avoidance (including increased depth ranges). This range varied from 100-200 m for typical vessels but extended to 400 m for noisy vessels. In general, fish showed a positive avoidance reaction to vessels when the radiated noise levels exceeded their threshold of hearing by 30 dB or more (Mitsen, 1995).

Sound sensitive species will be present in the BMG area during IMR activities. While sound levels generated by the IMR vessel are not expected to be sufficient to damage marine fauna (cetaceans, pinnipeds and fish) it is considered that localised and short-term displacement of sound sensitive species around the IMR vessel may occur. It is noted that the BMG location is located in the East of Eden upwelling which periodically attracts foraging blue whales. The vessel will be moving at a low constant speed within the BMG area so sound impacts are expected to be localised and correspondingly avoidance effects to these cetacean species will be localised (i.e. expected within 1-2 km), short-term and not significant at a population level (Consequence 2 - moderate).

Commercial fish species within proximity to the IMR vessel are also expected to have localised, short-term displacement around the vessel (~400-500 m), effects largely confined to the BMG PSZ. It is considered these impacts, given the size of the typical IMR vessels utilised, would be no greater than fishing trawlers which are present in the area. On this basis the impact is localised (Consequence 1 – minor).

6.4.4 Environmental Impact and Control Measure Summary

Aspect:	Vessel sound disturbance
Impact summary:	Disturbance to fauna from vessel sound.
Extent of impact:	Localized (immediately around vessel).
Duration of impact:	Short-term (duration of survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well documented and fauna sensitivities present are known.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard while reducing behavioural impacts to sound sensitive species to as low as reasonably practicable are:

- *Vessel Maintenance:* Noise radiated from vessels is reduced by ensuring vessel engine and propulsion systems are maintained in accordance with manufacturer's specifications;

- *Vessel/cetacean caution zones*: Vessels will adhere to proximity distances and vessel management practices for whales and dolphins as detailed in the Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8). This includes:
  - Vessels will travel at less than 6 knots within the caution zone of a cetacean and minimise noise (Caution Zone is 150m radius for dolphins and 300 m for whales);
  - The vessel must not drift closer than 50 m (dolphin) and 100 m (whale);
  - If whale comes within above limits, the vessel master must disengage gears and let the whale approach or reduce the speed of the vessel and continue on a course away from the whale;
  - If cetacean is disturbed immediately withdrawn at speed less than 6 knots;
  - The vessel must not restrict the path of the cetacean;
  - If a dolphin approaches the vessel, the master must not change the course or speed of the vessel suddenly.

6.5 Impact: Treated Bilge

6.5.1 Hazard

Routine oily water discharges from the IMR vessel's bilge water treatment system to marine waters is possible during NPP activities. Bilge water consists of water, oily fluids, lubricants, cleaning fluids, and other similar wastes that have accumulated in the lowest part of the vessel typically from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats prior to discharge overboard in order to meet the MARPOL requirement of no greater than 15 ppm oil-in-water (OIW) overboard.

6.5.2 Known and Potential Impacts

The known and potential environmental impacts of treated bilge water discharges to the marine environment are:

- Temporary and localised reduction in water quality (organics and toxics) around the discharge location; and
- Toxicity impacts to marine fauna through ingestion of contaminated water.

6.5.3 Evaluation of Environmental Impacts

Temporary and localised reduction of surface water quality

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges may temporarily reduce water quality locally around the discharge point. The bilge water will be rapidly diluted, dispersed and biodegraded to undetectable levels (Consequence 1 - minor).

Acute toxicity to marine fauna

Small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality however are not expected to induce acute or chronic toxicity impacts to plankton or marine fauna through ingestion or absorption through the skin (Consequence 1 - minor).

6.5.4 Environmental Impact and Control Measure Summary

Aspect:	Treated Bilge Discharge
Impact summary:	Degradation of water quality from treated bilge discharge.
Extent of impact:	Localized (immediately around vessel discharge point).
Duration of impact:	Short-term (intermittent during survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well understood and highly regulated.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard ensuring that bilge water discharges comply with MARPOL Annex I requirements are:

- *Oil Water Separation Equipment and treated bilge discharge quality:* For vessels > 400 tonnes, bilge water is treated in a MARPOL-approved OWS with oil-detection monitoring and shut-down control equipment operating. Discharge concentrations from the vessel is less than 15 ppm (OIW);
- *Treated Bilge Discharge Quality*: For vessels < 400 tonnes treated bilge water bilge water is treated in approved equipment which ensures an OIW content less than 15ppm while proceeding en-route;
- *Treated Bilge Discharge Quality*: If the OIW content of 15 ppm cannot be achieved, the oil residues must be retained in on-board storage tanks for onshore disposal or further treatment;
- *OWS Reliability*: OWS and oil detection equipment are routinely calibrated and maintained to ensure reliable discharge concentrations are met;
- *Residual Oils*: Residual whole oils from the OWS are contained on-board or pumped to tote tanks are disposed onshore.

6.6 Impact: Sewage and Grey Water Discharge (vessel)

6.6.1 Hazard

The use of ablution, laundry and galley facilities by vessel crew will result in the discharge of sewage and grey water. While the number of on-board the vessel/s at any one point in time is currently unknown, this activity may result in the intermittent discharge of several hundred litres of treated sewage and greywater each day during IMR activities.

6.6.2 Known and Potential Impacts

The known and potential environmental impacts of sewage discharges are:

- Temporary and localised reduction in water quality (organics and bacteria) around the discharge location;
- Increased biological oxygen demand; and
- Visual amenity impacts.

6.6.3 Evaluation of Environmental Impact

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

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

Intermittent release of sewage and greywater will cause localised nutrient enrichment of the water column. Sewage can also contain hazardous pathogens (including faecal coliform bacteria), intestinal parasites, viral agents that, if released untreated to the marine environment, may cause. Grey water can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, and coliform bacteria.

The effects of sewage and sullage discharges on the water quality at Scott Reef were monitored for a drill rig operating near the edge of the deep-water lagoon area at South Reef. Monitoring at stations 50, 100 and 200 m downstream of the platform and at five different water depths, confirmed that the discharges were rapidly diluted in the upper 10 m water layer and no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the numbers of personnel on-board a drill rig compared with IMR activities; and the environment much less dispersive than vessels which are moving in Bass Strait.

Discharges of treated sewage and grey water will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand (BOD) of the treated effluent is unlikely to lead to oxygen depletion of the receiving waters (Black *et al.,* 1994), as it will be treated prior to release. On release, surface water currents will assist with oxygenation of the discharge.

Given the high dilution and dispersal, low volumes and short discharge period, impacts to water quality and secondary impacts on marine life associated with sewage and grey water discharged from vessels during IMR activities is considered temporary and localised (Consequence 1 - minor).

6.6.4 Environmental Impact and Control Measure Summary

Aspect:	Vessel sewage discharge
Impact summary:	Degradation of water quality from treated sewage and grey water discharge.
Extent of impact:	Localized (immediately around vessel discharge point - <50 m radius and < 10 m water depth).
Duration of impact:	Short-term (intermittent during survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well understood and highly regulated.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure that sewage discharges comply with MARPOL Annex IV discharge requirements are:

- *Sewage Treatment Plant Standard:* Where sewage is treated, the sewage treatment plant meets MARPOL standards (i.e. IMO approved);
- *Sewage Discharge Quality*: Sewage discharges meet the following conditions:
  - Sewage treated in an IMO approved/compliant treatment plant and does not produce visible floating solids or discolouration of surrounding waters;
  - Sewage is comminuted and disinfected when vessel is > 3nm from nearest land and sewage originating from holding tanks is discharged at rates defined by Marine Order 96 while the vessel is proceeding en-route at a speed not less than 4 knots;
  - Sewage not comminuted or disinfected when vessel is > 12nm from nearest land and sewage originating from holding tanks is discharged at rates defined by Marine Order 96 while the vessel is proceeding en-route at a speed not less than 4 knots;
  - If discharges cannot meet these requirements, the sewage is retained on-board for onshore disposal/treatment.
- *Sewage Treatment Plant Reliability*: Sewage treatment equipment is routinely maintained in accordance with the vessel's planned maintenance system to maintain system performance.

6.7 Impact: Food-scrap Discharge (vessel)

6.7.1 Hazard

The generation of food waste from the vessel galley will result in the discharge of macerated putrescible waste.

It is expected that the average volume of putrescible waste discharged overboard from the vessel will vary depending on the number of Persons on Board (POB) and the types of meals prepared, but may be in the order up to 46 litres per day per person[6] (USEPA, 2011).

6.7.2 Known and Potential Impacts

The known and potential environmental impacts of food-scrap/putrescible discharges are:

- Temporary and localised reduction in water quality (nutrients) around the discharge location;
- Increased biological oxygen demand; and
- Increase in scavenging behaviour of marine fauna and seabirds.

6.7.3 Evaluation of Environmental Impacts

The overboard discharge of macerated food wastes has the result of creating a localised and temporary increase in the nutrient load of the surface waters. This may in turn act as a food source for scavenging marine fauna or seabirds, whose numbers may temporarily increase as a result. However, the rapid consumption of this food waste by scavenging fauna, and its physical and microbial breakdown, ensures that the impacts of putrescible waste discharges are insignificant (Consequence 1 - minor).

[6] This is based upon passengers on a cruise liner which are expected to generate more waste per capita than that of cargo or survey vessels.

6.7.4 Environment Impact and Control Measure Summary

Aspect:	Vessel food-scrap discharge
Impact summary:	Degradation of water quality from food-scrap discharges.
Extent of impact:	Localized (immediately around vessel discharge point).
Duration of impact:	Short-term (intermittent during survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well understood and highly regulated.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure that food-scrap discharges from vessels comply with MARPOL Annex V discharge requirements are:

- *Food-scrap Discharge Standard:* Putrescible waste is discharged overboard when:
  - For macerated food-scraps the vessel is greater than 3 nm from the coastline proceeding en-route;
  - For unmacerated food-scraps the vessel is more than 12 nm from the coastline proceeding en-route.
- *Macerator Equipment Standard*: A food macerator is on-board, functional, in use and set to macerate to ≤ 25 mm particle size;
- *Macerator Equipment Reliability*: Maceration equipment is routinely maintained in accordance with the vessel's planned maintenance system to ensure system performance.
- *Induction:* All vessel crew are aware of the vessel garbage management arrangements through information provided in the vessel induction;
- *Non-putrescible wastes*: Non-putrescible waste is returned to shore for disposal.

6.8 Impact: Air Emissions (vessel)

6.8.1 Hazard

The use of fuel (specifically marine-grade diesel) to power engines, generators and mobile and fixed plant (e.g., ROV, back-deck crane, generator), will result in gaseous emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SO_X) and nitrous oxides (NO_X). Combustion emissions will be expelled from exhaust stacks several metres above deck level to ensure adequate aerial dispersion

6.8.2 Known and Potential Impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality;
- Contribution to global greenhouse gas effect.

6.8.3 Evaluation of Environmental Impacts

Diesel combustion in vessels during IMR activities may result in a localised reduction in air quality. Greenhouse gases will also be produced via the combustion of diesel in vessel engines and on-board power generators, and on-board equipment.

The IMR vessel would typically consume 0.3m^3 of fuel per day which is 0.000000155% of the National Greenhouse Gas inventory for 2014 (DoEE, 2017q). Infrequent incineration of a small volume of solid waste may also occur and portable equipment on the back deck would emit minor volumes of combustion products.

Air emissions will disperse rapidly in prevailing winds and, given the volumes involved, are likely to cause only a temporary and highly localised effect on ambient air quality. Due to the temporary nature of IMR activities the air emissions generated would represent an insignificant contribution to overall greenhouse gas emissions. On this basis the emission poses a temporary and localised impact (Consequence 1 - minor).

6.8.4 Environmental Impact and Control Measure Summary

Aspect:	Air Emissions (Vessel)
Impact summary:	Degradation of local air quality and contribution to greenhouse gas emissions.
Extent of impact:	Localized (immediately around emission point).
Duration of impact:	Short-term (intermittent during survey)
Level of Certainty of Impact:	**HIGH:** Activity impacts well understood and highly regulated.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure that atmospheric emissions are limited to those necessary for operations with no complaints of poor air quality are:

- *Air Emissions Equipment*: Vessels with diesel engines > 130 kW must be certified to emission standards (e.g. IAPP, IEAPP);
- *Fuel Quality*: Vessels utilise low sulphur fuels to reduce SOx emissions from combustion sources (i.e. fuel that contained less than 3.5% m/m sulphur);
- *Shipboard Energy Efficiency Management Plan (SEEMP)*: Vessels > 400 gross tonnes and involved in an overseas voyage shall implement their Ship-board Energy Efficiency Management Plan (SEEMP) to monitor and reduce air emissions;
- *Equipment Maintenance:* Vessel equipment which emits combustion products (e.g. engines) is maintained in accordance with vessel planned maintenance system to ensure engines are operating to specification;
- *Fuel Monitoring*: Fuel consumption is monitored on IMR vessels (and portable back-deck equipment) and abnormally high consumption investigated;
- *Back-deck Equipment:* Back-deck portable equipment are inspected for condition prior to mobilization and routinely inspected during IMR activities for emissions;
- *Poor Air Quality Incidents:* All incidents of poor air quality will be reported as incidents and investigated in accordance with the Cooper/ Upstream PS Incident Investigation procedures.
- *Incineration meets MARPOL Annex VI Requirements*: If the vessel has incineration equipment and undertakes incineration:
  - The incinerator is IMO-certified;
  - Personnel responsible for the operation of the incinerator are trained; and
  - Operating parameters of the incinerator ensures the minimum flue temperature is maintained at 850^{o}C.

6.9 Risk: Introduction of Invasive Marine Species (IMS)

6.9.1 Hazard

The following activities have the potential to result in the introduction of invasive marine species (IMS) to the project area:

- Vessel ballast discharge containing IMS; or
- Translocation of foreign species through biofouling of the vessel hull, niches (e.g., sea chests, bilges, strainers) or ROV equipment.

6.9.2 Known and Potential Impacts

The known and potential environmental impacts of IMS introduction (assuming their survival, colonisation and spread) are:

- Ecological disruption through increased competition with native species and for resources; and
- Reduction in native species diversity and abundance.

6.9.3 Evaluation of Environmental Risk

Vessels have the potential to transport and introduce IMS from ballast water or biofouling of hull and niche areas. Successful IMS colonisation requires the following three steps (CoA, 2009):

- Colonisation and establishment of the marine pest on a vector (e.g., vessel, equipment, internal vessel niches or structures) in a donor region (e.g., home port where species is established);
- Survival of the settled marine species on the vector during the voyage from the donor to the recipient region; and
- Colonisation (e.g., dislodgement or reproduction) in the recipient region by the marine species, followed by successful establishment of a viable new local population.

IMS are likely to have little or no natural competition or predation, thus potentially outcompeting native species for food or space, preying on native species or changing the nature of the environment (Consequence 4 – Major). It is estimated that Australia has over 250 established marine pests, and it is estimated that approximately one in six introduced marine species becomes pests (DoEE, 2017u).

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries. Marine pests can also damage marine and industrial infrastructure, such as encrusting jetties and marinas or blocking industrial water intake pipes. By building up on vessel hulls, they can slow the vessels down and increase fuel consumption.

Contracted vessels for IMR activities are likely to be sourced from within Australia (typically Victoria) but if international vessels are contracted they will be required to be compliant with Australian quarantine entry requirements as detailed in Section 6.9.4 to ensure that the risk of IMS introduction from foreign ports is low. Additionally, given the depth of water at the BMG location (135-270m), it is considered extremely unlikely that pest species would thrive given the light limitations at those depths to become established.

On this basis, the residual risk is assessed as medium.

6.9.4 Environmental Risk and Control Measure Summary

Aspect:	Vessel Activity (biofouling and ballast discharge)
Impact summary:	Predation of native marine species and the possible loss of diversity and abundance of native marine species
Extent of impact:	Localised (isolated locations around the assets if there is no spread) to widespread (if colonisation and spread occurs).
Duration of impact:	Short-term (IMS is detected and eradicated, or IMS does not survive long enough to colonise and spread) to long-term (IMS colonises and spreads).
Level of Certainty of Impact:	**HIGH:** Impacts associated with IMS introduction have been extensively studied and the vectors of introduction established. Corresponding regulatory guidelines controlling these vectors have been established.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure that survey vessels entering and operating in the BMG area, and in-field equipment deployed during the survey carry a low risk with respect to IMS introduction are:

- *Contractor Pre-qualification*: Cooper/Upstream PS undertakes a vessel contractor pre-qualification to ensure that vessel biofouling controls meet regulatory guidelines. For small vessels (> 5000 tonnes gross and < 50m in length) this will utilise the IMCA Marine Inspection for Small Workboats Inspection Template and a project-specific vessel audit and inspection checklist for completion (including IMS requirements);
- *Ballast Water (International Vessels):* For international vessels, ballast water exchange has been undertaken in accordance with the Australian Ballast Water Management Requirements (DAWR, 2016) prior to entry into Australian waters;
- *IMS Risk Assessment (International Vessels and Vessels mobilising from ports outside IMCRA Twofold shelf bioregion):* For international vessels and vessels mobilising from ports outside the IMCRA Twofold shelf bioregion, an IMS risk assessment in accordance with Cooper/Upstream PS requirements is undertaken as part of pre-qualification (refer Section 7.2.1.2) and corrective actions implemented as determined by the risk assessment to ensure a low risk of IMS introduction;
- *International Anti-Fouling System (IAFS) Certificate (all vessels):* For vessels > 400 tonnes, vessels will carry a current International Antifouling System (IAFS) Certificate;
- *In-water Equipment:* In-field equipment removed from the water are inspected and cleaned after each deployment in Victorian waters.

6.10 Risk: Disruption to Commercial Shipping and Fishing

6.10.1 Hazard

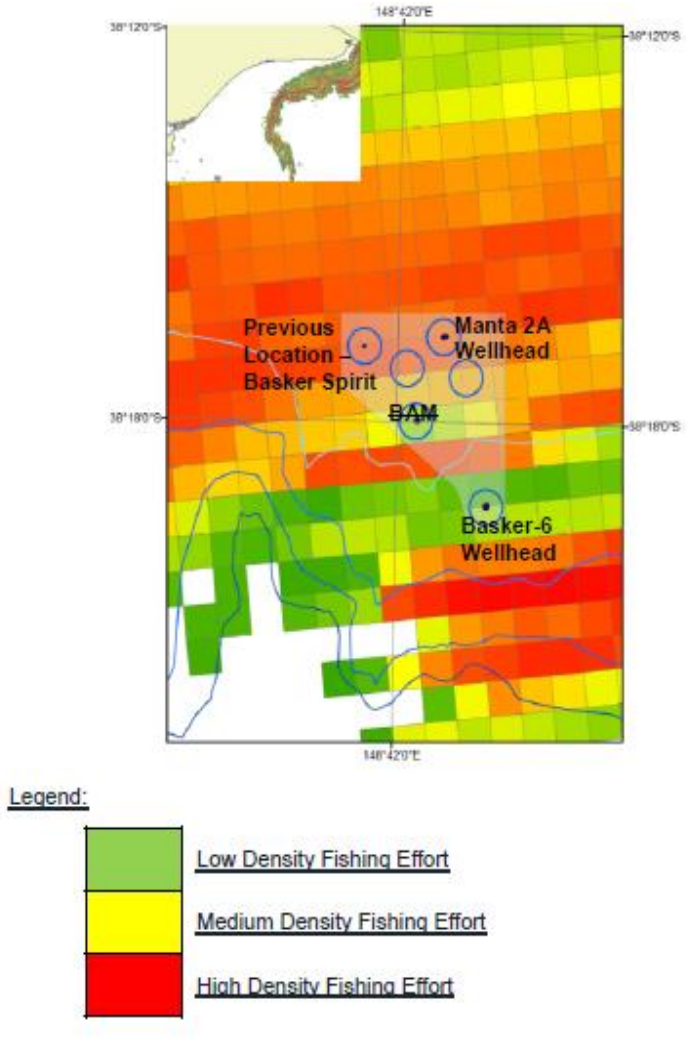
Commercial Fishing (Area Exclusion)

The BMG Development lies in productive commercial fishing grounds for Danish Seine and Otter-board Trawlers. The introduction of CMRs and closure of deep-water fishing areas (depths > 700m) has intensified impacts to fisheries associated with any *area access restrictions* in Bass Strait (i.e. oil and gas development infrastructure). Consultation with relevant fishing groups indicate that the Commonwealth Trawl Sector (CTS), represented by SETFIA is the predominant fishery group with a presence in the area although the Gillnet Hook and Trap Sector (predominantly gillnet) also fish in water depths to 183 m. As shown in Figure 6-1, BMG equipment located on the continental shelf is in an area previously considered to be highly fished, particularly in the area previously occupied by the Basker Spirit (now removed) and Manta-2A wells. Additionally a ‘trawl band’ exists between the BAM and Basker-6 well along the Basker-6 flowline corridor.

The NPP PSZ footprint has considered this feedback and removed all equipment not required for a Phase 2 Gas Development; mid-water equipment (dynamic risers) and the Basker-6 flowline corridor has been trenched to the extent practicable. The footprint, and its subsequent access restrictions, has been minimised as far as possible to reduce commercial fishery impacts. The areas returned to the fisheries from the Phase 1 Oil Development have had the seabed condition verified via ROV survey to ensure no snag hazards from hydrocarbon-related equipment. Additionally the condition of previous exploration well sites (Manta-1, Basker-1 and Gummy-1) has been surveyed with respect to fishing obstructions.

Fishery groups continue to be consulted on a regular basis and any future development activities will consider the fishing activities which occur in the area. Further area release is pending a decision on the Manta Gas Development.

Figure 6-1: Historic Trawl Density in BMG Area



All Commercial Vessels (Fishing and Merchant Shipping Disruption):

As most IMR vessel activities are undertaken within the BMG NPP PSZ, disruption to commercial shipping and fishing activities for the majority of the activity is not anticipated. However, the IMR vessel will transit across the trenched Basker-6 flowline (not protected by a PSZ) will operate outside the gazetted PSZ which may disrupt commercial fishing and shipping activities.

6.10.2 Known and Potential Hazards

BMG NPP PSZ Presence:

The known and potential impacts associated with the BMG NPP PSZ are the loss of access to the area by commercial fishing interests.

BMG NPP IMR Activity:

The known and potential impacts associated with interference to commercial fishing and shipping users in the area are:

- Deviation of vessels around IMR activities;
- Damage to fishing equipment;
- Loss of commercial catch; and
- Possible vessel collision.

This section deals with interference on a spatial (socio-economic) basis only. Diesel spill risk associated with a vessel collision from a diesel spill is addressed in **Section 6.16.**

6.10.3 Evaluation of Environmental Risk

BMG NPP Presence:

The BMG Oil Development footprint, together with exclusion from marine reserves and fishing closures for stock rebuilding, has concentrated fishing activity. Maintaining accessibility to seabed areas is important to commercial fisheries present in the BMG area. Removal of equipment and trenching the Basker-6 flowline in 2012 released 64% of the BMG Oil Development footprint which was isolated from fisheries. Further reduction in the radius of the PSZ (& hence development footprint) is not considered responsible given the possibility of increased risk to equipment integrity from third party (marine) users activities. This may lead to issues with BMG equipment reuse and hence viability of a possible Manta Gas Development. On this basis, the impacts to commercial fisheries as a result of access restrictions has been minimised to the extent practicable while still maintaining viability of the future development.

From a social impact/risk perspective, the presence of the BMG subsea facilities has been the subject of fishery group complaints and adverse local attention (business reputation) (Consequence 3 – serious). Given the current NPP footprint which has been minimised as far as possible, together with the continued dialogue and liaison on the development with impacted fishing groups, Cooper/Upstream PS considers any further adverse attention to be very unlikely and the residual risk is assessed as medium.

BMG NPP IMR Activity:

The BMG asset lies outside of the Area to be Avoided (ATBA). Accordingly, vessel prohibition over 200 tonnes (gross) afforded to assets which lie within the ATBA, cannot be applied to BMG IMR activity outside the BMG NPP PSZ. Bass Strait carries high traffic volume and a traffic separation scheme operates within the basin to prevent vessel incidents.

In accordance with previous protocols adopted for BMG IMR activities, Upstream PS/Cooper initiates maritime warnings (Notice to mariners, AusCoast warnings) to third party vessels for IMR activities. For fishery specific stakeholders, IMR activity notifications are provided by SETFIA to the local fishing fleet prior to, during, and at completion of the IMR activity on behalf of Cooper/Upstream PS. Additional mitigations including the monitoring of, and communicating with, third party vessels by the vessels' bridge during IMR activities also minimises the potential for disruption.

It is noted that most of the IMR activity is undertaken within the BMG PSZ which excludes third party vessel entry. The PSZ is shown on Navigation Charts and is contained within local fishing fleet vessel plotters to ensure third parties are aware of the BMG infrastructure presence.

Possible impacts to commercial vessels associated with IMR activities include minor deviation in vessel routes which potentially lead to an increase in fuel consumption or interruption to planned fishing tow lines (Consequence 1 - minor). However with the adopted notification protocols it is considered that spatial conflicts would be extremely unlikely. The residual risk is assessed as low.

6.10.4 Environmental Risk and Control Measure Summary

Aspect:	Petroleum activity within commercial fishing and shipping areas
Impact summary:	Interference with commercial shipping and fishing activities (route deviation, lost catch, damaged equipment)
Extent of impact:	Localised
Duration of impact:	Short-term (IMR activity), Medium-term (PSZ area fisheries exclusion)
Level of Certainty of Impact:	**HIGH:** Impact associated with commercial fishing and shipping in the area is well understood.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and ensure no incidents or complaints of spatial conflict with commercial fishing and shipping during IMR activities are:

- *Navigational Requirements (Charts):* BMG infrastructure is marked on navigation charts;
- *Navigation Requirements (PSZ)*: BMG has a PSZ gazetted around the infrastructure;
- *Fishery Plotters (Infrastructure Installation):* All local fishing vessels have the BMG PSZ installed into their plotters;
- *Fishery Notifications:* Cooper/Upstream PS will notify fishing industry associations of pending IMS activity one month prior to commencement and five days prior to mobilisation.
- *Fishery Notifications:* SETFIA will send activity reminders via SMS during IMR activities to local fishermen.
- *Navigational Requirements (Vessel/Contractor):* Contractor selection criteria verifies that vessel complies with class certification requirements under the Navigation Act 2012; Marine Order 27 (Safety of Navigation and Radio Equipment) 2016; and Marine Order 30 (Prevention of Collisions) 2009;
- *Vessel Watch (Activity):* Visual and radar watch is maintained on the bridge at all times.
- *Vessel Watch (Competency):* The vessel master and deck officers will have a valid STCW certificate in accordance with Marine Order 70 (seafarer certification) (or equivalent) to operate radio equipment to warn of potential third party spatial conflicts;
- *Navigational Warnings:* AMSA Rescue Coordination Centre (RCC) is notified of the IMR survey activities 24-48 hours before commencement, at survey commencement and at completion. A daily notification of vessel position is made to the RCC.
- *Navigational Warnings:* The Australian Hydrographic Service (AHS) is advised 4 weeks prior to IMR activity commencement to allow for the issue of a Commonwealth Notice to Mariners;
- *Spatial Conflict Incidents:* All incidents of spatial conflict will be reported to Cooper/Upstream PS via the Upstream PS incident management procedure;

- *Fishing Damages Protocol:* Damage to fishing equipment/catch incurred through BMG seabed equipment left outside the NPP PSZ is available to compensate.

6.11 Risk: Injury to Megafauna (vessel strike)

6.11.1 Hazard

The movement of vessels undertaking IMR activities has the potential to result in collision with megafauna, such as cetaceans and pinnipeds.

6.11.2 Known and Potential Impacts

The known and potential environmental impacts associated with vessel strikes to marine fauna are injury or death.

6.11.3 Evaluation of Environmental Risk

Cetaceans and pinnipeds are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly 'bow ride' with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel (e.g., narwhals) while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al*., 1995).

Peel et al. (2016; cited in DoEE, 2016b) reviewed vessel strike data (1997-2015) for marine species in Australian waters and identified the following:

- Whales including the humpback, pygmy blue, Antarctic blue, southern right, dwarf minke, Antarctic minke, fin, bryde's, pygmy right, sperm, pygmy sperm and pilot species were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction followed by the southern right whale. A number of these species may migrate through the waters of the BMG assets.
- Dolphins including the Australian humpback, common bottlenose, indo-pacific bottlenose and Risso's dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. A number of these species may reside in or pass through the waters of the BMG assets.
- There were no vessel interaction reports during the period for either the Australian or New Zealand fur seal. There have been incidents of seals being injured by boat propellers, however all indications are rather than 'boat strike' these can be attributed to be the seal interacting/playing with a boat, with a number of experts indicating the incidence of boat strike for seals is very low.

Literature identifies that most collisions between vessels and cetaceans occur on the continental shelf reflecting areas of high usage by both vessels and cetaceans. In general the populations which are most frequently struck are those living on or near busy vessel routes (particularly shipping of ferry routes) or where there is an unusual concentration of vessels in a shallow, confined area (e.g. east coast of America or Canary Islands) (Dolman et al. 2006).

Laist et al. (2001) has identified that larger vessels (container vessel and fast ferries), moving in excess of 10 knots may cause fatal or severe injuries to cetaceans, with the most severe injuries caused by vessels travelling faster than 14 knots.

IMR vessels will operate on a 24/7 basis for the duration of the survey.

The BMG area lies within the "east of Eden upwelling" area, which is an intermittent upwelling where foraging pygmy blue whales may be present.

Collision with marine fauna with survey vessels/equipment is credible however, due to the slow speed of the IMR vessel while undertaking survey activities, if contact made with species, the impact is expected to be non-life threatening. Accordingly, the likelihood of vessel strike and associated severe injury or death of an individual whale or dolphin (Consequence 3 - serious) is considered extremely unlikely during NPP activities.

The residual risk for this hazard is low.

6.11.4 Environmental Risk and Control Measure Summary

Aspect:	Vessel strike to megafauna
Impact summary:	Fauna injury or death.
Extent of impact:	Limited to individual pinnipeds or cetaceans in direct contact with vessel (no large scale population impact).
Duration of impact:	At a population level, impact is considered short-term
Level of Certainty of Impact:	**HIGH:** Impacts from cetacean and pinniped strikes have been studied and the impacts are well documented resulting in the new draft strategy document.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and prevent injuries or death of megafauna resulting from vessel collision during IMR activities are:

- *Vessel/Cetacean Caution Zones:* Vessel movement adheres to the proximity distances and vessel management practices of the Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8) which includes:
  - Vessels will travel at less than 6 knots within the caution zone of a cetacean and minimise noise (Caution Zone is 150m radius for dolphins and 300 m for whales);
  - The vessel must not drift closer than 50 m (dolphin) and 100 m (whales);
  - If whale comes within above limits, the vessel master will disengage gears and let the whale approach or reduce the speed of the vessel and continue on a course away from the whale;
  - If a cetacean is disturbed the vessel shall immediately withdraw at speed of less than 6 knots;
  - The vessel must not restrict the path of a cetacean;
  - If a dolphin approaches the vessel, the master must not change the course or speed of the vessel suddenly.
- *Observations during Vessel movement in Petroleum Activity Area*: Marine fauna observation will be undertaken during vessel movements in the petroleum activity area.
- *Environmental Induction:* All survey personnel on-board have completed an environmental induction covering the requirements for cetacean/vessel interaction consistent with EPBC Regulations 2000 (Chapter 8) and are familiar with the requirements. This includes a requirement to notify the bridge if a cetacean is sighted.
- *Reporting Vessel Strikes:* Any vessel strike incident to whales or dolphins shall be reported as soon as possible via the National Vessel Strike Database; to DoEE within 7 days and NOPSEMA within 2 hrs.
- *Other Marine User Notifications:* The vessel master shall alert other marine users of the presence of whales in the area via radio.

6.12 Risk: Waste overboard Incident

6.12.1 Hazard

Small quantities of hazardous/non-hazardous materials will be used and wastes created, handled and stored on the vessel. In the normal course of operations, solid and liquid hazardous/non-hazardous materials and wastes will be stored until transfer to port facilities for disposal at licensed onshore facilities. However, accidental releases to sea are a possibility, especially in rough ocean conditions when items may roll off or be blown off the deck.

The following non-hazardous materials and wastes will be returned to shore, but have the potential to be accidentally dropped or disposed overboard:

Solid non-biodegradable wastes:

- Paper and cardboard;
- Wooden pallets;
- Scrap steel, metal and aluminium;
- Glass; and
- Plastics and rope.

Hazardous wastes:

- Hydrocarbon contaminated material (e.g., oily rags, oil filters, hydraulic oils); and
- Batteries, empty paint cans, cleaning products, aerosol cans, fluorescent tubes.

6.12.2 Known and Potential Impacts

Potential impacts associated with these accidental releases include:

- Disturbance (smothering or pollution) of seabed habitats;
- Injury, ingestion or entanglement by marine fauna (particularly plastics by turtles and seabirds);
- Hydrocarbon contaminated wastes can result in localised water quality reduction (including toxics); and
- Litter (visual pollution).

6.12.3 Evaluation of Environmental Risk

The accidental release of these materials may extend kilometres from the release site (as buoyant waste drifts with the currents) or will be localised for non-buoyant items that drop to the seabed.

Solid non-biodegradable/hazardous wastes will be handled in accordance with the vessel's Garbage Management Plan which will work to a 'no solid non-biodegradable/hazardous waste overboard' policy. In normal circumstances, no impacts to the marine environment should occur. However, accidental release to the marine environment is possible. The assessment of risk follows:

- For windblown material while the volume is small, materials such as plastic impact individual animals (i.e. mortality). The TSSC (2015) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species). Given the presence of threatened species in the region, the worst-case possible impact has been assessed as mortality to a protected species (single animal) (Consequence 3 -

serious). With the on-board controls, as detailed in Section 6.12.4 implemented, an incident is considered extremely unlikely and the residual risk is assessed as low.

- Solid hazardous waste, such as paint cans containing paint residue and batteries would be expected to settle on the seabed if dropped overboard. Over time, if this is not retrieved, it may result in the leaching of hazardous materials to the seabed, resulting in small localised areas of substrate becoming toxic and unsuitable for colonisation by benthic fauna. The habitat in the BMG area is not of significant conservation value (Consequence 1 – minor). With on-board controls implemented, an incident is considered extremely unlikely and the residual risk is assessed as low.
- Hazardous (liquid) wastes released may cause water quality reduction with either direct or indirect effects on marine organisms. Impacts would be localised around the release, prior to being rapidly diluted and dispersed by the surrounding seawater. Therefore pollution of the surrounding waters would be temporary, localised and impacts recoverable (Consequence 1 - minor). With the on-board controls implemented incidents are considered unlikely and the residual risk is assessed as low.

6.12.4 Environmental Risk and Control Measure Summary

Aspect	Release of solid hazardous/non-hazardous waste overboard to the marine environment
Impact summary:	Localised decrease in water quality with possible toxicity impacts to marine biota (e.g. fish plankton). Injury or damage to individual marine fauna through ingestion of plastics. Localised seabed smothering or contamination by non-buoyant solid hazardous waste.
Extent of impact:	In general, localised impacts around point of discharge. Solid, buoyant materials will be dispersed by local currents and may travel long distances, but volumes will be small
Duration of impact:	Short-term (water quality impact). Longer term (seabed smothering, species ingestion)
Level of Certainty of Impact:	**HIGH:** Impacts from waste disposal overboard (particularly plastics) has been well studied and documented. This is verified through the production of regulatory guidelines for threat abatement from marine debris.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and prevent releases of hazardous or solid wastes overboard during IMR survey activities are:

- *Garbage Management Plan:* For vessels > 100 gross tonnes or vessels certified to carry more than 15 people, the IMR vessel will operate under a Garbage Management Plan. This Garbage Management Plan incorporates the requirements of IMO Resolution MEPC. 219(63)with respect to waste minimisation and garbage handling; and disposal restrictions on solid and hazardous waste (reflecting MARPOL Annex V requirements).
- *Crew Induction:* Crew members are inducted into garbage management procedures to minimise the potential for wastes discharged overboard and to ensure effective waste segregation;
- *Waste Overboard (Recovery):* Wind-blown or solid waste overboard is recovered if reasonably practicable (by ROV or other means as appropriate).
- *Waste Handling and Disposal:* Handling of solid and hazardous wastes on-board the survey and support vessels will comply with the requirements of *Protection of the Seas (Prevention of Pollution from Ships) Act 1983.* This may include:
  - No discharge of general operational or maintenance wastes or plastics or plastic products of any kind;
  - Waste containers are covered with tightly fitting, secure lids to prevent any wastes from blowing overboard;

- All solid, liquid and hazardous wastes (other than bilge water, sewage and food wastes) are incinerated or compacted (if possible) and stored in designated areas before being sent ashore for recycling, disposal or treatment;
- Any liquid waste storage on deck must have at least one barrier (i.e. bunding) to prevent deck spills entering the marine environment. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place;
- Correct segregation of solid and hazardous wastes.

6.13 Risk: Equipment loss to the environment

6.13.1 Hazard

IMR activities utilise ROVs to undertake visual inspections of subsea facilities. This equipment or vessel equipment utilised in IMR activities may be dropped overboard or lost to the environment during IMR activities.

6.13.2 Known and Potential Impacts

The known and potential impacts of equipment loss to the environment are:

- The presence of a marine hazards leading to impacts on third party vessels or equipment (e.g. fishing nets);
- Benthic habitat impacts through physical contact

6.13.3 Evaluation of Environmental Risk

It is possible that during the use of ROVs during survey activities, the control umbilical may be caught in the IMR vessel propeller and severed. In such an event the ROV would drift (if neutrally buoyant) or sink to the seabed smothering the benthos within its footprint (typically small ~1m x 1m).

In the event of seabed contact by a dropped object, impacts to benthic species in the sandy habitats which prevail and have widespread distribution in Bass Strait, are considered localised will be rapidly recolonised via adjacent benthic fauna on equipment removal (Consequence 1 - minor). With control measures adopted, this event is considered very unlikely this event would occur and the residual risk is assessed as low.

Neutrally buoyant equipment can present a hazard to other marine users which operate in the area (e.g., fishermen). Collision with equipment may cause damage to fishing vessels/ equipment (Consequence 1 – minor). Again with control measures adopted, this event is considered very unlikely and the residual risk is assessed as low.

6.13.4 Environmental Risk and Control Measure Summary

Aspect	Release of equipment to the marine environment
Impact summary:	Marine hazard causing potential damage to third party vessels. Localised benthic habitat disturbance.
Extent of impact:	Localised if lost to seabed. Possible to drift long distances if neutrally buoyant.
Duration of impact:	Short-term (equipment retrieved). Longer term (equipment lost)
Level of Certainty of Impact:	**HIGH:** Equipment loss during surveys has occurred within the industry with causal factors well understood and controls developed to prevent loss. Impacts within the affected environment can be reasonably derived.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and prevent loss of equipment to the marine environment are:

- *Equipment Deployment/Retrieval:* ROV operations are undertaken by qualified and competent personnel (IMCA or equivalent competency standard) in accordance with approved procedures.
- *Pre-dive Inspections:* ROV undergoes a pre-dive inspection to verify the equipment is fit-for-purpose. This will include controls to prevent control umbilical entanglement and detection of ROV if lost to marine environment.
- *ROV Loss (Recovery):* If ROV lost, all attempts made to retrieve and recover are made.
- *Stakeholder Notifications:* Marine stakeholder notifications (VHF Channel 16) are made in the event of an in-water equipment loss;
- *Stakeholder Notifications:* Loss of equipment will be reported to AMSA as soon as possible of the potential hazard to other mariners;
- *Stakeholder Complaints*: All marine stakeholder complaints associated with the in-water equipment loss will be recorded and actioned (as appropriate).

6.14 Risk: Loss of Containment – Spills

As part of the BMG NPP impact and risk assessment, the following spill risk was identified:

- *BMG Infrastructure Integrity Loss of Containment (LOC)*

  The following credible threats may lead to a LOC from BMG infrastructure:

  – Miscellaneous dropped objects or anchor drags from large third-party commercial fishing or shipping vessels; and

  – Corrosion or mechanical failure from subsea equipment component/equipment failure.

  Refer to Section 6.15 for an assessment of these LOC events.

- *IMR Activity Spills (Vessel-based)*

  The following credible causal pathways may lead to a potential LOC of chemicals/hydrocarbons from IMR activities:

  – Back-deck activities (e.g. equipment refuelling, chemical/oil handling);

  – Hydraulic line failure from equipment (back-deck or in-water);

  – Vessel collision leading to fuel tank rupture/release.

  Note that:

  – Vessel drift or powered grounding is not considered credible given the distance from shore of the BMG assets and the lack of emergent features in the vicinity of the BMG assets.

  – Given the close proximity of the BMG assets to port facilities (i.e. Lakes Entrance) refuelling activities will be undertaken in port and not at sea.

  – Vessel selection will address the appropriate vessel standards and class requirements for the proposed IMR activities and vessel audits will verify if any integrity issues are present with the vessel.

  Refer to Section 6.16 for an assessment of vessel collision fuel tank LOC events.

6.14.1 Hazard – Minor Spills (ROV, Deck Spills)

The following activities have the potential to result in minor spills (< 200 litres) to the marine environment:

- Vessel hydraulic hose leak;
- Vessel material bulk storage or package chemical leak (deck spill); or
- ROV hydraulic hose leak.

6.14.2 Known and Potential Impacts

The potential environmental impacts of minor spills (< 200 litres) to the marine environment are:

- Localised degradation of water quality; and
- Toxic effects to the marine environment including marine fauna and benthic habitats.

6.14.3 Assessment of Environmental Risk

Vessel leaks: Small volumes of chemicals and oils are stored on-board the IMR vessel. These storage and handling locations with a spill risk have either permanent or temporary bunding to prevent spill residues from entering the marine environment. In the event of a spill, crew have been trained in spill response and have access to Chemical Safety Data Sheets (SDSs) and spill clean-up equipment to remove spill residues.

Deck cleaning detergents utilised in deck cleaning activities are biodegradable and not a 'harmful substance' in accordance with MARPOL Annex III.

ROV or vessel hydraulic hose leaks: IMR activities will normally utilise observation class ROVs which are electrically operated and contain only small amounts of liquid in the thrusters (~ 250 ml in each thruster) and the sonar head (~ 500 ml). Typical fluids include Hyspin 5 (thrusters) and Shell Diala (sonar head).These fluids are unlikely to be released to the environment.

It is possible that ROVs utilised for IMR activities may be hydraulically controlled. A credible release scenario is the control umbilical becoming entangled in subsea obstacles which, on a worst case basis, may lead to a control line breakage and hydraulic oil discharge to the environment. It is estimated that the total volume of hydraulic oil held in the ROV hydraulic system is ~ 200 litres. These spill incidents are small in size and are expected to rapidly dissipate and dilute in the high energy environment of Bass Strait. Given these low volumes, the impact is expected to be localised, short-term and recoverable (Consequence 2 - moderate). With controls adopted, it is considered that these types of spill event which enter the marine environment are very unlikely and the residual risk is assessed as low.

6.14.4 Environmental Risk and Control Measure Summary

Aspect	Spills from IMR activities, ROV activities or vessel activity
Impact summary:	Degradation of water quality. Toxic impacts to marine environment (marine fauna and benthic habitats).
Extent of impact:	Localised only
Duration of impact:	Short-term and recoverable
Level of Certainty of Impact:	**HIGH:** Spill source volumes are limited in size and the environmental impact of discharge is understood.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP demonstrated via compliance with legislation, codes and standards; adoption of good industry practice and application of professional judgement*.

Control measures to be implemented to control this hazard to prevent spills to the environment, or to limit discharges/impacts if a spill to the environment occurs are:

- *Vessel-based Spills (Containment)*: All vessel storage and chemical handling areas are bunded to contain spills. Housekeeping within these areas is maintained at high standards.
- *ROV Spills (Pre-dive Inspections):* ROV undergoes a pre-dive inspection to verify the equipment is fit-for-purpose (serviced and maintained, pressure hoses appropriately rated and in good condition).
- *ROV Spills (Trained Operators- Spill Prevention):* ROV operations are undertaken by qualified and competent personnel (IMCA or equivalent competency standard) in accordance with approved procedures.
- *Deck Detergent (Biodegradability)*: Deck cleaning detergents are biodegradable and not a 'harmful substance' in accordance with MARPOL Annex III requirements.
- *Chemical Assessment (Storage and Handling of Chemicals on Deck)*: All chemicals which are stored or handled on deck are assessed in accordance with the Cooper/Upstream PS chemical selection process as part of contractor selection and activity planning activities to reduce any potential spill impacts.
- *Vessel-based Spills (Safety Data Sheets (SDSs)):* All hazardous materials on-board have SDSs which are readily available.
- *Vessel-based Spills (Crew Training):* Marine crew undertake regular on-the-job training in spill response techniques. Routine spill response drills are undertaken on-board the vessel.
- *Vessel-based Spills (Spill Response Kits):* Spill response bins/kits are located in close proximity to high spill risk areas. The kits are routinely checked for their adequacy and replenished as necessary.
- *Vessel-based Spills (SMPEP Implementation – Source Control):* The vessel-specific Shipboard Marine Pollution Emergency Plan (SMPEP) (or equivalent appropriate to class) and spill clean-up procedure is implemented in the event of a spill to prevent/limit discharge/impacts to the environment.

6.15 Risk: LOC – BMG Infrastructure

6.15.1 Hazard

Credible threats to subsea equipment integrity leading a LOC include:

- Miscellaneous dropped objects or anchor drags from third party vessels; and
- Corrosion or mechanical failure from subsea equipment component/equipment failure.

In the event of integrity breaches from BMG infrastructure, the following hydrocarbon release rates may result:

- **Production Wells**: Subsurface and tree safety control valves on the production wells[7] have tested multiple barriers and are closed to reservoir hydrocarbons. Whilst safety control valves (i.e. SSSVs and Christmas tree valves) have been successfully leak tested to within the criteria of API 14B/H, this test method is not a 'leak-tight' standard and over time valves may pass hydrocarbon and re-pressurize the subsea equipment. Given the static operational nature of the production wells, any hydrocarbon ingress is expected to be gas.

[7] The B5 PMV has not been closed due to residual cement in the valve from well intervention activities. Double barrier provision in this well is provided through the reservoir abandonment activity conducted during the recent DWIC.

The NPP risk assessment looked at credible failure mechanisms and determined the incidents which might result in a hydrocarbon release from production wells. These are[8]:

- Via **third party impact damage** (e.g. container vessel anchor drag) to the wellhead up to a maximum rate of 0.022 MMSCFD (650 kg/d) gas together with approximately 0.75 BBL/d[9] of condensate may be expected to be released to the environment for a 20 day period. On a longer term basis, a leak rate of 130kg/day with small amounts of condensate may be expected after this initial period. Negligible amounts of non-condensate hydrocarbon liquids (i.e. BMG crude) will be released. Consequences associated with this gas/condensate release will be localised with minimal clean-up (i.e. a moderate consequence);
- Via **corrosion/seal degradation of down-hole and tree well barriers,** loss of containment from production well annulus/tubing might result in a maximum credible release rate of 0.022 MMSCFD (gas) and 0.75 BBL/d (condensate) to the environment. Negligible amounts of non-condensate hydrocarbon liquids could be released. Consequences associated with this type of release would be localised with minimal clean-up (i.e. a moderate environmental consequence);
- Via **failure of the TRSV or ICV control system seals,** loss of containment from the production well annulus/tubing might result in a maximum possible release rate of 19 kg/d (gas) with minimal condensate to the environment however the release ;rate is more likely to be of the order of 0.5-2 kg/d (gas). The consequence associated with this type of release is considered minor;
- Via **tree valves leaking past seat/seals** or **internal/external corrosion**, loss of containment from the wellhead may result in a maximum of 20kg/d (gas) and minor amounts of condensate leaking to the environment. Negligible amounts of non-condensate hydrocarbon liquids would be released to the environment and the environmental consequences associated with this release would be minor;
- Via a **hydrocarbon leak into the Basker-2 down-hole control line system**, loss of containment from the wellhead might result in a maximum release rate of 40kg/d (gas) with negligible condensate however the expected rate would be approximately 1-2kg/day (gas). Consequences associated with this release would be minor.

- **Flowlines and Basker-A manifold (BAM) (contains potentially re-pressurised inhibited water/hydrocarbon)**: NPP equipment has been left in a state where hydrocarbons present in subsea equipment has been minimised as far as practicable. Hydrocarbon sources feeding the subsea equipment (production wells) are closed and have been leak tested to within the criteria of API RP14B/H. Over time well valves may pass gas and re-pressurize liquid-filled flowlines and umbilicals. Additionally, a discrete volume of gas has been introduced to the BMG flowline system as a result of the Basker-5 well intervention activities. As above, given the static operational nature of the production wells, hydrocarbon ingress into this equipment is expected to be gas. Hydrosure™ 0-3670RD (Dyed), the flowline inhibition chemical, is a corrosion inhibitor/oxygen scavenger which was classified as a 'gold' chemical under the UK OCNS at the time of inhibition, however with a substitution warning (chemical is no longer listed under that system).

  Note also that the Basker-6 flowline carries residual diesel volumes from previous dewaxing activities (estimated at 2.3m^3).

[8] These incidents have been conservatively assessed for maximum volumes released.

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

The following credible incidents which may result in an inhibited water/hydrocarbon release from the BMG flowlines/BAM are detailed below[10] (refer to NPP Risk Assessment 3826-HS-H0106):

- For flowlines via third party impact, dropped objects damage or internal/external corrosion mechanisms, loss of containment may result in inhibited water/hydrocarbon release. Maximum initial hydrocarbon release volumes are estimated at 460kg (gas) per day with small amounts of condensate. Longer term gas release rates are likely to be under 2kg/d or less. For the Basker-6 flowline (only), given the residual diesel presence in the flowline, in addition to the gas release, a maximum diesel release volume of 2.3m^3 might occur if flowline integrity is compromised. The environmental consequences associated with this type of release will be localised (i.e. moderate); and
- For the BAM via third party impact, dropped objects damage or internal/external corrosion mechanisms, maximum initial hydrocarbon release volumes are estimated at 230kg (gas) per day with small amounts of condensate. A special case is the B6 flowline where the initial volume is estimated at 70kg. Longer term gas release rates are assessed to be under 20kg/d. The environmental consequences associated with this type of release will be localised (i.e. - moderate).

- **Umbilicals (contains potentially re-pressurised Transaqua HT2™/Hydrocarbon):** As per the flowline case, repressurisation of control umbilicals is not possible from valve passing events. Under the OCNS system, Transaqua HT2™ is assessed as a non-CHARM product (Initial Grouping-Group D).

  Loss of containment from umbilicals (Transaqua HT2™/hydrocarbon) may credibly occur as a result of **third party impacts or dropped objects damage**[11]. An estimated long-term gas release rate of 1-2kg/d (gas) and very small amounts of condensate may be expected during this type of incident. Consequences associated with this type of release will be negligible.

6.15.2 Known and Potential Impacts

The potential environmental impacts of a hydrocarbon leak on BMG infrastructure are:

- Degraded water quality around the release site;
- Toxic effects to the marine environment including marine fauna.

Within the BMG PSZ receptors may include marine mammals (dolphins, fur seals and migratory whales), seabirds (albatross and petrels), fish and plankton species.

6.15.3 Evaluation of Environmental Risk

6.15.3.1 Gas Condensate Release

All BMG equipment has been designed in accordance with industry codes. As part of preparation for the NPP, all flowlines were depressured and moveable liquid hydrocarbon downstream of the tree valves flushed from the system. All wells had at least two independent mechanical barriers confirmed and tested on the tubing side with one downhole barrier. All SSSVs and wellhead valves were verified closed. Given the static nature of the wells and leakage pathways through valves, any hydrocarbon ingress is expected to be gas.

[10] These incidents have been conservatively assessed for maximum hydrocarbon volumes.

[11] These incidents have been conservatively assessed for maximum volumes.

For the maximum condensate leak rate of 120 litres/day preliminary modelling undertaken identified no surface sheens were predicted from the release (APASA, 2012). Hydrocarbon dispersal through the water column may lead to some localised areas of elevated hydrocarbon concentration. Screening calculations identify for this release size and for a range of oil droplet sizes between 20 – 500 µm, ANZECC (2000) 'trigger' concentrations for total petroleum hydrocarbons (TPH) of 7 ppb (99% species protection) would only be expected within 0.7 m of the leak source.

Given these maximum rates do not create visible sheens, surface dwelling, air breathing fauna (whales, turtles, etc.) are not expected to be impacted. Pelagic species such as fish and plankton may be exposed to low levels of entrained hydrocarbon, however given the localised nature of the release and their mobility in the environment, no measurable impacts would be expected to these species.

For the gas released at the seabed associated with this condensate release (0.022MMSCFD or 26 m^3/hr (standard conditions)), gas is expected to rapidly dissipate through the water column into the atmosphere given its relative density compared with water. Methane has a low solubility is water and given the residence time within the water column, negligible impacts to water quality are expected.

As a LOC from BMG facilities is predicted to be gas/condensate, given the density differences between gas, condensate and water and small levels of release expected, minimal exposure to benthic fauna is expected.

Maximum release rates have been conservatively assessed as Consequence 2 (moderate).

Likelihood of LOC:

The BMG facilities have been monitored for integrity since 2012. Within that time there has been two surveys[12] which observed "very small" bubble releases[13] from a fitting on the Basker-2 well. Monitoring identifies that the leak is intermittent, decreasing in volume and poses a negligible environmental impact. The monitoring of a similar fitting on Manta-2 well has not identified any releases.

No significant leaks or third party interference with the BMG infrastructure have been identified during monitoring events. Given the control measures adopted to prevent third party threats (refer Section 6.15.4), the measures undertaken to preserve equipment from internal and external corrosion, and the status of the equipment, the likelihood of the worst credible release rate being realised is considered extremely unlikely.

The residual risk is assessed as low.

6.15.3.2 Diesel Release (Basker-6 Flowline)

A *surface* EMBA for a Basker-6 flowline diesel spill has been conservatively calculated at a 264m (lateral radius @ 10µm thickness on surface) from a surface release site[14]. The actual EMBA of a *subsurface* diesel leak from the Basker-6 flowline (2.3m^3 maximum) will be smaller given the plume will undergo significant dispersion within the water column.

Assuming all the diesel volume is lost from the flowline it would rapidly rise and spread on the sea surface to visible sheens (below ecological impact levels). Given the small volume released, surface sheens are not expected to last for a significant period of time, particularly in the high energy BMG environment where entrainment within the water column would allow for rapid dilution and dispersion. Given these localised and temporary surface oil levels, any marine

[12] Note that the inspection during 2014 did not observe bubbles.

[13] 8 bubbles per minute during 2013 and 3 bubbles per minute during 2016.

[14] This does not allow for water column dispersion or any evaporative effects on reaching the sea surface.

mammals and migratory bird species present during the release are not expected to be affected. Fish species present may be exposed to low levels of hydrocarbon, however given their mobility in the environment, the exposure period would be fleeting and no measurable impacts would be expected (Consequence 2 - moderate).

The residual risk is assessed as low.

6.15.3.3 Transaqua Release

Service control lines to the SSSV and Completion Isolation Valves were depressurised, disconnected from the well pressure sources, capped and left filled with Transaqua HT2™ – a water miscible hydraulic control fluid with a non-Charm product rating 'D' under the OCNS scheme at the time of preservation. The umbilicals were left in a storm-safe condition.

Given the depressurised status of these lines, their isolation from pressure sources and the head of water above the control umbilical (135-270 m), leakage in the event of an umbilical failure would be insignificant. Transaqua HT2™ is assessed as a non-CHARMable product (currently listed at non-CHARMable 'D'). The key ingredient within Transaqua is Ethylene Glycol (25-50%) which is listed as a substance which poses little of no risk (PLONOR) (OSPAR, 2013). The SDS indicates this product is readily biodegradable and is not expected to bio-accumulate.

On this basis, impacts to water quality and subsequent impacts to marine species are expected to be negligible (Consequence 1 - minor) in the event of an umbilical leak.

The residual risk is assessed as low.

6.15.3.4 Inhibited Water Release

Inhibited water may also be released in the event of a flowline rupture or leak. Assuming that flowlines have become re-pressurised over time, the fluid profile across the flowline, based upon the SG of its contents, would be in the order (top to bottom) - gas, condensate and inhibited water. The location of the rupture would determine the material lost before the flowline reached equilibrium with seabed pressure. In the event of a flowline rupture or leak the compressible fluid portion of the flowline contents would expand in volume to the seabed pressure with an estimated 46 m^3 of inhibited water displaced from the flowline. Once the gas has reached seabed equalisation pressure, the release of inhibited water should reduce significantly.

Hydrosure 0-3670R, the inhibitor chemical dosed at 650 ppm in water for flowline preservation, has been shown to degrade by approximately 20% over 12 months in a field trial at 10°C (Chevron, 2015). Hydrosure O-3670R is a biocide and toxic to marine biota, however the concentration of the compound (& hence the toxicity) is expected to have reduced since initial dosing.

Based upon a review of Hydrosure O-3670R and testing on analogous substances (quaternary ammonium chloride or ADBAC) containing the same active component as Hydrosure, the components was found not to bioaccumulate and displayed a half-life between 8 to 15 days in seawater (highly biodegradable) (Chevron, 2015). Testing undertaken to determine the No Observable Effects Concentration (NOEC) identified a concentration of 0.06 mg/l (99% species protection) and 0.1 mg/l (95% species protection) (Chevron 2015).

Given the small volumes expected to be released from the flowline and the dynamic current conditions at the BMG location, it is expected that any inhibited water release will be rapidly dispersed with receiving waters to levels below NOECs. Waters impacted will be localised with only minor environmental impact predicted (worst case) (Consequence 2 – moderate).

As this material is water miscible, there is no surface oiling effects from a flowline release.

The residual risk is assessed as low.

6.15.4 Environmental Risk and Control Measure Summary

Aspect	BMG Infrastructure LOC
Impact summary:	Degradation of water quality. Secondary impacts to marine fauna (pelagic).
Extent of impact:	Localised only
Duration of impact:	Short-term (leak eliminated) or possibly longer-term (only if leak is considered ALARP and acceptable). Impacts are temporary (during leak) and recoverable.
Level of Certainty of Impact/risk:	**HIGH:** Spill source volumes are limited in size due to preservation and testing activities undertaken on the assets and the environmental impact of this discharge is understood.
Uncertainty: Impact/risk Decision Framework	Infrastructure is routinely monitored to assess for integrity. This process is risk-based and accepted within the industry. In the event of an anomaly (leak), an engineering assessment is undertaken and rectification actions determined ensuring environmental impacts are ALARP and acceptable and a net benefit is realised (refer source control section). For external threats such as commercial fishing, the activity is well understood and represents normal business (i.e. impact decision framework **category A**). ALARP is demonstrated through adoption of compliance with legislation, codes and standards, adoption of good industry practice and application of professional judgement. For threats such as corrosion, the threat mechanisms are well understood and amenable to assessment using established data and engineering risk assessment methods (impact decision framework **category B**). ALARP is demonstrated through engineering risk assessment using well established methodologies on subsea equipment data obtained during GVIs.

Control measures to be implemented to control this hazard and prevent or mitigate impacts of a release to the environment are:

- *Gazetted BMG PSZ on Navigation Charts*: BMG PSZ is identified on navigation charts.
- *Fishing Plotters*: Local fishing fleet plotters are upgraded to contain BMG PSZ location.
- *Fishing Risk Assessment*: Upstream PS/Cooper monitor changes to the fisheries (e.g. new vessel masters, new vessels, increased fishing activity) at the BMG location to assess for additional controls which may need to be implemented to maintain commercial fishing risk to ALARP.
- *IMR Activities (Asset Integrity Management/Source Control):* Inspection of BMG subsea infrastructure is undertaken in accordance with the BMG Subsea IMR Engineering Assessment Procedure. After each inspection, IMR results are reviewed and corrective actions identified and implemented to preserve asset integrity.
- *IMR Activity (IMR Activity Impacts):* The scope of the IMR activity undergoes risk assessment to eliminate IMR activity risks to BMG infrastructure. Controls identified are implemented via a Permit-to-Work during the activity.
- *Oil Pollution Emergency Plan (OPEP) Implementation*: The BMG OPEP is implemented in response to a spill during IMR activities.

In the event that a continuous leak is identified:

- *Water Quality Sampling and Analysis*: Water quality sampling and analysis is undertaken if a continuous leak is observed in accordance with the protocols contained in the Cooper Offshore Victoria Operational and Scientific Monitoring plan (OSMP). Initial sampling will be undertaken in a down-current direction at the leak source (0.5-1.0m), at 2m and 5 m from the source to establish radial concentration profile. Water quality results will be used to inform the source control actions and design of subsequent monitoring events.

6.16 Risk: LOC – Vessel Fuel Tank

6.16.1 Hazard

The IMR vessel in the field in the presence of third party vessels has the potential to lead to a potential collision incident and subsequent LOC of a fuel tank.

The hazard assessment for this risk has utilised an IMR vessel with a fuel tank size of 50 m^3. IMR vessels previously used on the BMG have had a largest fuel tank size of 11.5 m^3. The vessel will utilise marine diesel oil (MDO) (or marine gas oil) as a fuel source for the vessel during IMR activities.

MDO is a common marine fuel used in vessel engines and is a mixture of both volatile and persistent hydrocarbons and is classified as a Group II hydrocarbon and classified as a light persistent oil (AMSA 2015). Table 6-3 provides the physical properties of MDO.

Table 6-3: MDO boiling ranges and physical characteristics (RPS-APASA, 2017)

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low volatiles (%)	Residuals (%)	Density (kg/m^3)	Dynamic viscosity (cP)	Pour Point (°C)
Boiling point (°C)	<180	180-265	265-380	>380			
MDO	6	34.6	54.5	5	829.1 @ 25°C	4 @ 25 °C	-14
	Non-persistent			Persistent			

MDO Behaviour at Sea:

The general behaviour of a MDO release on the sea surface includes the following:

- The hydrocarbons spreads very rapidly with the slick elongated in the direction of prevailing wind and current;
- Evaporation is the dominant process contributing to the removal of MDO from the sea surface and can account for 60-70% loss (depending on wind conditions and sea temperature);
- A strong tendency to physically entrain in the upper water column in the presence of moderate winds (i.e. > 12 knots) or in breaking waves and can re-float if these energies abate.

The physical properties of marine diesel limit the available spill response options which may be adopted to respond to a spill. Given the rapid spreading characteristics of the fuel, together with the evaporative loss, rapid slick break-up is expected. Spill response techniques such as containment and recovery and dispersant application are ineffective on these types of hydrocarbons (ITOPF, 2011).

Oil Spill Modelling:

Cooper/Upstream PS engaged RPS-APASA (2017) to undertake modelling for this MDO spill scenario. The spill scenario modelled was a 50 m^3 instantaneous spill from the Manta-2A location (closest point to coastline). Modelling was undertaken on an annualised basis for 200 individual spill simulations and tracked for a 20 days period. Thresholds adopted to interpret modelling results are provided in Table 6-4.

Table 6-4: Hydrocarbon thresholds utilised for impact assessment

Threshold	Supporting Literature
SEA SURFACE OILING	
LOW: 0.5-10 g/m^2 (0.5-10µm)	This threshold provides a measure of visual extent of an oil slick on the surface and while the threshold is not at a level at which ecological impacts occur, it does define a threshold of 'community concern' particularly around high tourism areas. ***This threshold has been selected to define socio-economic impacts and is the defined EMBA for this EP.***
MODERATE: 10 - 25 g/m^2 (10 -	This is the minimum thickness of oil that could impart a lethal dose to wildlife that

Threshold	Supporting Literature
25µm)	comes into contact with surface hydrocarbons. Research has shown that harm to seabirds through preening contaminated feathers or loss of thermal protection in their feathers occurs at 10µm to 25µm (French-McCay, 2009). ***This threshold has been selected to define ecological impacts***
HIGH: > 25 g/m^2 (> 25µm)	A concentration of surface oil greater than 25 g/m^2 which is expected to be harmful to marine birds that comes in contact with the slick. Marine birds may be affected should they come into direct contact with the hydrocarbon, and mortality may result from ingestion during preening, or from hypothermia from matted feathers.
SHORELINE OILING	
OIL STAIN/FILM: 10-100 g/m^2	A conservative threshold to assess the potential for socioeconomic impact such as the need for shoreline clean-up on man-made features/amenities. Thresholds below 100g/m^2 are considered to 'stain' shoreline fauna and are not considered to impact the species survival and reproductive capacity (French-McCay, 2009).
OIL COAT: 100-1000 g/m^2	This threshold is considered enough to coat shoreline animals and likely impact their survival and reproductive capacity (French-McCay, 2009). Thus 100 g/m^2 (approximately equivalent to 100 µm) is considered the ecological threshold for impacts to invertebrates living on hard substrates (rocky, artificial/man-made, rip-rap, etc.) and sediments (mud, silt, sand or gravel) in intertidal habitats. French-McCay (2009) based on the work of Albers (1980) identifies a 100µm as having a significant potential to affect the survivability and breeding success of protected shoreline birds while a reduction to 50µm identified no significant reduction in hatchling success. Threshold is also identified in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone (AMSA, 2015). ***This threshold has been selected to define ecological impacts***
OIL COVER: > 1000 g/m^2	More than 1,000 g/m^2 of oil during the growing season would be required to impact marsh plants. Similar thresholds have been found in studies assessing oil impacts on mangroves. Threshold is representative of higher level ecological impacts (i.e. ecosystem wide impacts).
DISSOLVED AROMATIC HYDROCARBONS	
LOW EXPOSURE (6 ppb – 96Hr LC_{50}): 576 ppb-hrs Very Sensitive Species (99% species protection)	French-McCay (2002) undertook a global review of available ecotoxicity data for multiple species across a wide taxonomic range to estimate the magnitude of toxicity effects to marine biota. This included 115 fish species, 129 crustacean species and 34 other invertebrate species which were predominantly derived from species at their most sensitive early life stages (i.e. eggs, larvae and juveniles). As early life stages are more sensitive than adults, results of the review represent conservative values. The outcomes of the review established lethal effects concentrations to fish and invertebrates (LC_{50}) from dissolved aromatic hydrocarbons over a period of 96hrs, under different environmental conditions. Concentrations varied from 6ppb to 400ppb with an average of 50ppb for Poly-aromatic Hydrocarbon (PAH) components. On this basis, LC_{50} values of 6ppb (99% species protection); 50ppb (95% species protection) and 400ppb (50% species protection) represent the range of exposures which could elicit a toxic response. *Note for MDO, toxic compounds are very light and evaporate very quickly; consequently their presence in the environment is short and insufficient to cause significant impact levels.*
MODERATE EXPOSURE (50 ppb – 96Hr LC_{50}): 4,800 ppb-hrs Average sensitive species (95% species protection)	
HIGH EXPOSURE (400 ppb – 96Hr LC_{50}): 38,400 ppb-hrs Tolerant species (50% species protection)	
ENTRAINED PHASE HYDROCARBONS	
LOW EXPOSURE (7 ppb – 96Hr LC_{50}): 672 ppb-hrs Very Sensitive Species (99% species protection)	The Predicted No Effects Concentration (PNEC) (1% affected fraction) accords with the 'trigger value' of 7ppb (Total Petroleum Hydrocarbon (TPH)) (99% species protection) (ANZECC, 2000) derived by Tsvetnenko (1998). This acts as conservative estimate of TPH water quality criteria to protect aquatic biota at constant discharge rates to the environment. ***This threshold has been selected to define the entrained phase EMBA.***
MODERATE EXPOSURE (70.5 ppb – 96Hr LC_{50}): 6768 ppb-hrs Average sensitive species (95% species protection)	Scholten et al (1993; cited in Smit et al, 2008) undertook a review of No Observable Effects Concentrations (NOECs) for 26 marine organisms exposed to several types of oils. All test exposures focussed on whole-organism effects (reproduction, growth and survival) and test exposure times exceeded 7 days to represent chronic exposure of 17 marine species from five taxonomic groups. A species sensitivity distribution (SSD) curve was constructed based upon these chronic NOECs and Predicted No Effects Concentration (PNEC) or Hazardous Concentration (HC5) of 70.5 ppb (THC) (95% species protection) and HC50 of 804 ppb (50% species protection) were determined. <u>The HC5 based upon chronic NOECs serves as the threshold for the protection of ecological structure, which is considered more sensitive than ecosystem functioning</u>.
HIGH EXPOSURE (804 ppb – 96Hr	

Threshold	Supporting Literature
LC_{50}): 77,184 ppb-hrs Tolerant species (50% species protection)	As identified in OSPAR (2012), the HC5 (or PNEC) is considered the maximum continuous (chronic) concentration level for total hydrocarbons in Produced Formation Water discharges in the North Sea, one of the most concentrated areas in the world for oil and gas production. This 'threshold' approach is considered representative of 'weathered' entrained MDO in the water column, given the low level of aromatics within the fuel, the rapid evaporation of lighter ends on release (surface) and water-washing of entrained hydrocarbons within the marine environment in the first 24hrs.

The results of the spill modelling are provided in Table 6-5.

On a deterministic basis, the single trajectory with the largest swept area had a total swept area of 259 km^2 at low exposure levels (i.e. 0.5µm+ or visible oil) and 6 km^2 at moderate sea surface exposure levels (10 µm or actionable sea surface oil). Actionable sea surface oiling is present for a period of 3hrs only after the spill event.

Table 6-5: MDO Oil Spill Trajectory Modelling Results (RPS-APASA, 2017)

Scenario	Results	
Surface water	**Sea surface exposure**	**Shoreline Contact**
0.5-10 g/m^2 (low exposure)	Travelled a maximum of 72.8km, favouring the east-northeast (refer Figure 6-2)	No shoreline contact
10-25 g/m^2 (moderate exposure)	Travelled a maximum of 9.9km, favouring the east-northeast	No shoreline contact
>25 g/m^2 (high exposure)	Travelled a maximum of 3.1km to the east northeast	No shoreline contact
Dissolved phase		
>576ppb.hrs (low exposure)	Dissolved aromatic concentrations did not persist in water column to trigger threshold.	
>4,800ppb.hrs (moderate exposure)	Dissolved aromatic concentrations did not persist in water column to trigger threshold.	
>38,400ppb.hrs (high exposure)	Dissolved aromatic concentrations did not persist in water column to trigger threshold.	
Entrained phase		
>672ppb.hrs (low exposure)	Observed up to 45km northeast of the release site (refer Figure 6-3).	
>6,768ppb.hrs (moderate exposure)	Threshold was not triggered	
>77,088ppb.hrs (high exposure)	Threshold was not triggered	
Shoreline		
LOW EXPOSURE: >10g/m^2	No shoreline contact predicted at these thresholds.	
MODERATE EXPOSURE: >100g/m^2	No shoreline contact predicted at these thresholds.	
HIGH EXPOSURE: >1000g/m^2	No shoreline contact predicted at these thresholds.	

Figure 6-2: Zones of potential oil exposure on sea surface for instantaneous 50 m³ MDO release (RPS-APASA, 2017)

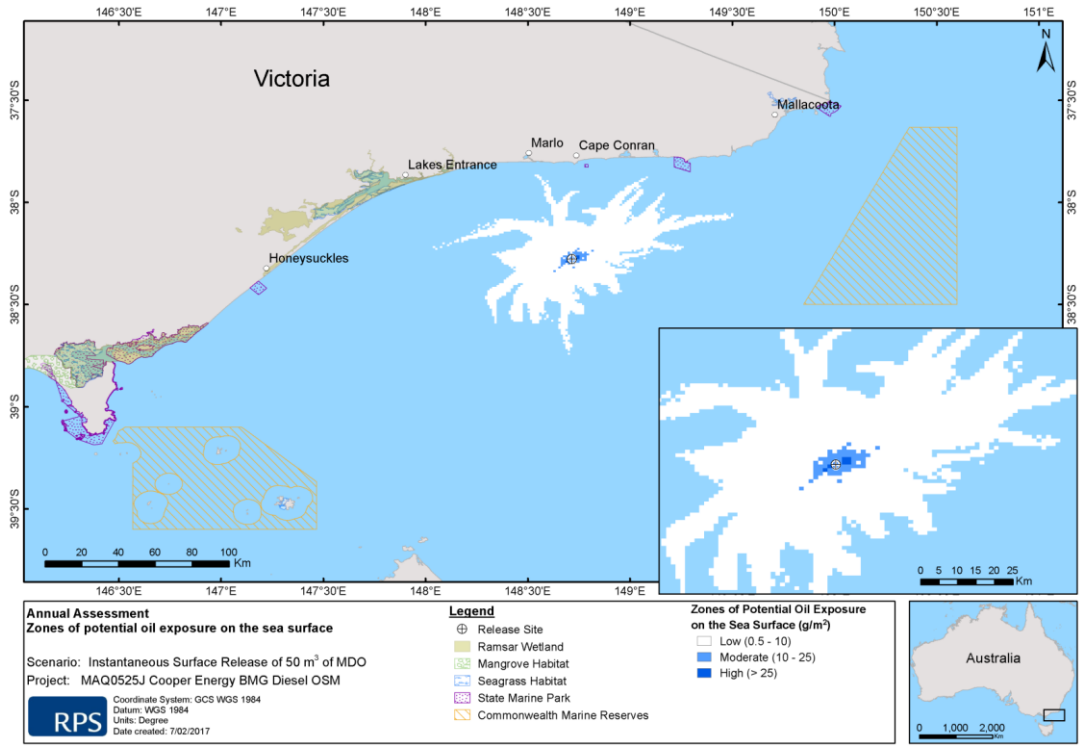
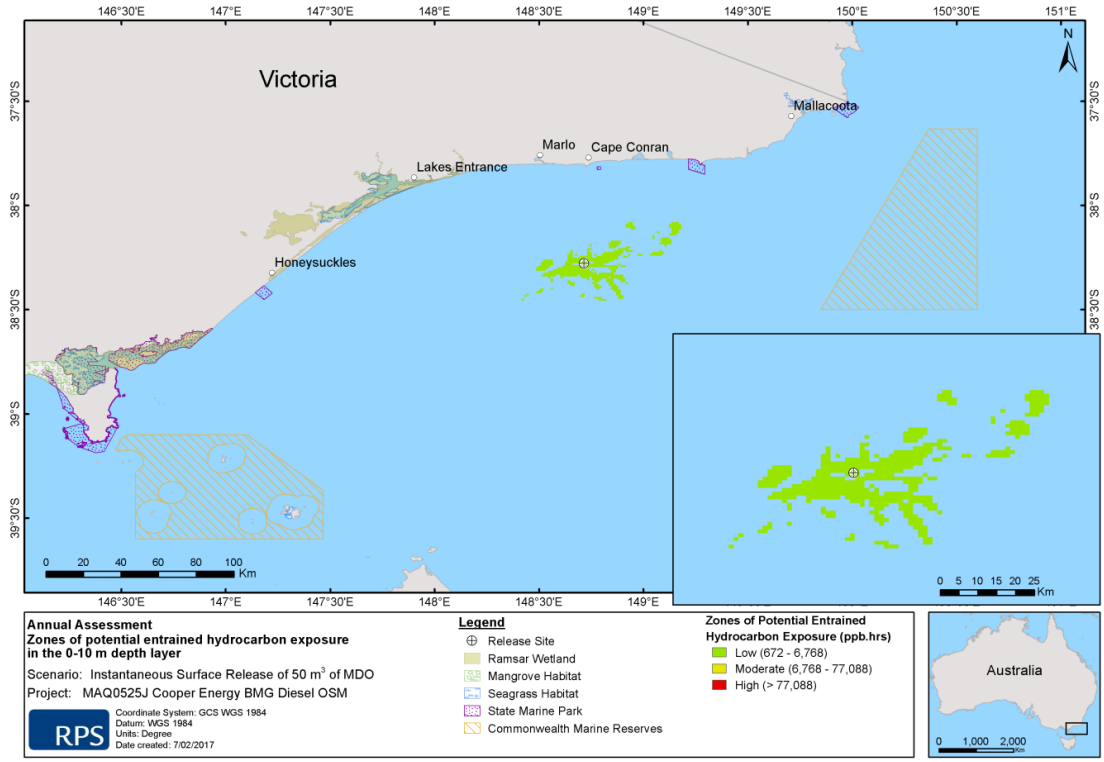


Figure 6-3: Zone of potential entrained hydrocarbon (0-10m depth layer) for instantaneous 50m³ MDO spill



6.16.2 Known and Potential Impacts

The known and potential impacts of a MDO spill within the marine environment are:

- Toxic effects to the marine environment including marine fauna;
- Degradation of water quality; and
- Tainting to commercial fish catch.

6.16.3 Evaluation of Environmental Impacts and Risks

Marine receptors within the EMBA potentially affected by spill residues, together with their lethal and sub-lethal impacts, are provided in Table 6-6.

Table 6-6: Marine receptors and impacts and effects to receptors

Receptor	Potential Impact
Cetaceans	• Cetaceans can be exposed to hydrocarbons by consuming oil or contaminated prey; inhaling oil compounds when surfacing; dermal contact through direct contact with oils and maternal transfer of contaminants to embryos. • Effects can include – hypothermia due to conductance changes in skin, resulting in metabolic shock; Toxic effects and secondary organ dysfunction due to ingestion of oil; congested lungs; damaged airways; Interstitial emphysema due to inhalation of oil droplets and vapour; Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding; Eye and skin lesions from continuous exposure to oil; Decreased body mass due to restricted diet; and Stress due to oil exposure and behavioural changes. • French-McCay (2009) identifies a 10-25µm oil thickness threshold has a probability of 0.1% mortality to cetacean species if they encounter these thresholds based on the proportion of time spent at surface. *Impacts for BMG MDO spill*: Cetaceans present may be exposed to very localised zones of exposure (6 km^2) for very short periods of time (3 hrs) which may lead to impacts on cetaceans. Biological consequences of physical contact by individual whales with this localised area are unlikely to lead to significant long-term impacts. Population level effects on cetaceans are considered to be MODERATE (Consequence 2).
Pinnipeds	• Fur seals are vulnerable to oil as a result of oil adhering to fur. Heavy oil coating and tar deposits on fur seals may result in reduced swimming ability and lack of mobility out of the water (AMSA, 2014b). Oil residues may also disguise scent that seal pups and mothers rely upon to identify each other which may lead to pup abandonment and starvation. • Ingestion of oil may damage digestive tracts; suppress immune systems or damage mucous membranes (AMSA, 2014b). Fur seals possess only a thin subcutaneous fat layer instead having a thick pelage that thermally insulates the animal (NOAA, 2006) and can suffer from hypothermia when oiled; • Surfacing in fresh oil slicks can also have sub-lethal impacts on sensitive tissues (e.g. mucous membranes around eyes and nasal cavities) leading to corneal abrasions, conjunctivitis and ulcers (AMSA, 2014b). It is also possible for hydrocarbon accumulation in fatty tissues due to the ingestion of contaminated prey (Brady et al. 2002). • French-McCay (2009) estimates encounter with a 10-25 µm oil thickness carries a 75% probability of mortality to the species based upon the proportion of time the species spends at the sea surface. *Impacts for BMG MDO spill*: Foraging pinnipeds are expected to be present in the BMG MDO EMBA. Given the rapid evaporation of diesel, the limited time and spatial area of the surface diesel slick is at 10µm thicknesses it is expected that that if present in the area, individual pinnipeds may be temporarily affected however no population level impacts are expected (Consequence 2 - moderate).
Turtles	• Turtles through surfacing activities may contact a surface slick which may coat the species and allow for inhalation exposure. Turtles may experience skin irritation and injury to airways or lungs, eyes and mucous membranes of the mouth and nasal cavities (AMSA, 2014b). • From the Montara crude oil spill turtles also exhibit severe dermal pathologies (particularly in the softer skin of the neck) through surfacing behaviour (Gagnon, 2010). A stress response associated with this exposure pathway includes an increase in the production of white blood cells, and even a short exposure to hydrocarbons, such as crude oil, may affect the functioning of their salt gland (Lutcavage *et al*., 1995). • Adult sea turtles spend 1-10% of their time at the surface with each dive lasting between 30-70 minutes (French-McCay, 2009). French-McCay (2009) identified that a 10-25µm oil thickness has a probability of 5% mortality to turtle species based on the proportion of the time turtles spend at surface. *Impacts for BMG MDO Spill*: Adult turtles may transit through the BMG MDO EMBA but the area is not a recognised BIA for the species.

Receptor	Potential Impact
	Given the small spill volume and its rapid evaporation only individual turtles might be affected. Due to the sparse nature of turtles within the Gippsland Basin, potential impacts of this MDO spill to marine reptile populations are considered to be moderate (Consequence 2).
Seabirds	• Seabirds are particularly vulnerable to hydrocarbon spills owing to their high potential for contact at the sea surface where they feed or rest. Ingestion of oil can be sub-lethal or acute depending on the type of oil, its weathering stage and inherent toxicity. This can occur directly when preening or by consuming contaminated prey. Effects may include tissue and organ damage, altered metabolism, pneumonia and reduced reproduction capability (AMSA, 2014b). Exposure to hydrocarbons may have longer term effects, with impacts to population numbers due to decline in reproductive performance and malformed eggs and chicks, affecting survivorship and loss of adult birds. • Direct contact with surface hydrocarbons can lead to irritation of skin and eyes. Oil-coated birds can suffer hypothermia, dehydration, drowning and starvation, and become easy prey. • Smothering of feathers can also lead to excessive preening, diverting time away from other behaviours leading to starvation and dehydration. Preening of oiled feathers will also result in to ingestion of hydrocarbons and the associated impacts of toxicity and potential illness. *Impacts for the BMG MDO spill*: Seabirds are expected to be present in offshore open waters of the EMBA. The EMBA is a BIA for albatross species (foraging). Given the rapid evaporation of diesel, the limited time and spatial area of the surface diesel slick is at 10µm thicknesses, it is expected that individual birds might be affected however this would not be significant at a population level. Accordingly, only a localised short-term impact to the species population would occur (Consequence 3 - serious).
Sharks and Fish	• In the open ocean, most pelagic species are highly mobile and demersal fish live relatively deep in the water column and are unlikely to contact surface spills. Fish and sharks do not generally break the sea surface however it is possible that individuals may feed at the surface. • Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth. 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 and therefore demersal fish communities are not expected to be impacted. • Shark species inhabit all levels of the water column and feed on fish and seals. Impacts to sharks may occur through direct contact with entrained hydrocarbons contaminating tissues and internal organs or indirect contact via the food chain (consumption of prey). Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling and burrowing behaviour (Kennish, 1996). For commercial shark and fish stock this also includes tainting (refer *commercial fishing).* • Eggs, larvae and young fish are relatively sensitive to oil (particularly dispersed oil), as demonstrated in laboratory toxicity tests (AMSA, 2014b), however there are no case histories to suggest that oil pollution has significant effects on fish populations in the open sea. This is partly because any oil-induced deaths of young fish are often of little significance compared with natural losses each year through natural predation and as fish spawn over large areas (AMSA, 2014b). *Impacts for the BMG MDO spill*: Pelagic free-swimming fish and sharks are not expected to suffer long or short-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2010)[15]. Given the limited areal and temporal presence of the spill and the limited numbers of fish potentially affected, impacts are assessed as temporary, localised and recoverable (MINOR consequence). Impacts on eggs and larvae entrained in the upper water column are not expected to be significant given the temporary period of water quality impairment, and the limited 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. Impact is assessed as temporary and localised (Consequence 1 - minor).
Benthic Fauna	• Invertebrates reside in benthic substrates and as such surface oil is not considered to pose a high risk to invertebrates except where oil reaches shoreline (not applicable to MDO spill). • Exposure to entrained phase hydrocarbons may lead to local impacts (mortality) to larval stages impacting on recruitment for that year. • Hydrocarbon contamination can lead to tainting (e.g. lobsters took 2-5 months to loose taint when exposure to light hydrocarbon (NOAA, 2002)). • Oil drops can mechanically affect filter feeders or expose invertebrate to semi-soluble hydrocarbons taken up by gills of digestive tract (McCay-French, 2009). • Sub-lethal hydrocarbon concentrations can lead to narcosis (death-like appearance when the organism has not actually died). The invertebrates often recover but are more vulnerable to predators or being

[15] Source: ITOPF Technical Information Paper No 3: Oil Spill Effects on Fisheries (2010)

Receptor	Potential Impact
	swept away by currents. Other sub-lethal effects of oil on invertebrates include developmental problems such as slow growth and deformities (Fingas, 2001). *Impacts for the BMG NPP MDO spill*: Given the small volume of MDO spilt at surface and its deep water location, no significant impacts to benthic fauna are expected (Consequence 1 - minor).
Plankton	• Exposure to hydrocarbons at surface or in the water column can result in changes in species composition with declines or increases in one or more species or taxonomic groups (Batten, 1998). Phytoplankton may also experience decreased rates of photosynthesis (Goutz *et al*., 1984; Tomajka, 1985). For zooplankton, direct effects of contamination may include suffocation, changes in behaviour, or environmental changes that make them more susceptible to predation (Chamberlain and Robertson, 1999). • Numerous studies on the influence of oil on plankton communities has been carried out, including one study by Varella et al (2006) which compared results from the Prestige oil spill with other published studies. Despite the limitations of the review (oil type, environmental conditions, etc.) it was not possible to demonstrate any significant effects on planktonic communities and changes were in the range of natural variability. Variations in the temporal scale of the ocean appear to have a greater influence on plankton communities than the direct effect of spilt hydrocarbons. *Impacts for the BMG MDO spill*: As plankton is widely distributed and dispersed through the upper layers of the water column it is expected that current induced drift would rapidly replace any oil affected populations (ECOS, 2001). Once background water quality conditions are re-established, planktonic communities will rapidly re-establish due to high population turnover with and short generation time that buffers the potential for long-term population declines (ITOPF, 2011). Based on the limited areas temporarily affected by surface and entrained oils, impacts are short-term, recoverable and localised and not expected to have a significant impact on plankton populations (Consequence 1 - Minor).
Commercial Shipping	No impacts are expected to commercial shipping.
Commercial Fishing	Impacts to fish species from diesel spills are outlined above in Fish and Sharks. The following additional impacts may be experienced by commercial fishing activities in the area: • Significant levels of surface oil can foul vessels and equipment used to catch commercial fish, and transfer contaminants to the catch. For fisheries operating in the BMG EMBA area, this would occur when demersal trawl/line and gillnets are retrieved through surface slicks to the vessel. • Studies have indicated that fish tainting may occur when exposed to diesel at low hydrocarbon concentrations (~250 ppb) (Davis et al. 2002). Tainting is reversible but, whereas the uptake of oil taint is frequently rapid, the depuration process where contaminants are metabolised and eliminated is slower (weeks to months) (ITOPF, 2010) making commercial species unpalatable. Fish have a high capacity to metabolise hydrocarbons while crustaceans (such as lobster and crab) have a reduced ability (NOAA, 2002). 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. *Impact for the BMG NPP MDO Spill*: Given the very small volumes of diesel released to the environment and its rapid dispersion, individual fish in the vicinity of the spill source may be affected by taint however this will be temporary and localised – not sufficient to cause contamination issues with consumers. Localised impacts from the MDO spill are also not expected to affect fishing activities (localised and temporary) (Consequence 2 - moderate).
Oil & Gas	No impacts are expected to adjacent oil and gas facilities.

Spill Mitigation:

The IMR vessels will operate under an approved SMPEP (or equivalent for vessel class) in accordance with MARPOL 73/78 Annex I requirements and as required by the *Protection of the Sea (Prevention of Pollution by Ships) Act 1983* Section 11A. Information contained in the SMPEP includes personnel responsibilities for the deployment and maintenance of response equipment; the emergency plan in case of pollution; communications/contacts required in the event of a spill (i.e. AMSA details); measures to control and limit the oil flow; and the required forms to be completed and transmitted to regulatory authorities.

For a vessel collision incident resulting in a spill, the actions taken by the vessel master would typically include:

- Make safe the vessel and crew;
- Immediate notification to AMSA (in Commonwealth waters) advising on location, oil spill volume, nearby sensitivities, etc.;

- Implement SMPEP remedial measures to limit volumes spilt (i.e. close water tight doors, check bulkheads; assess damage; determine whether vessel separation will increase spillage; isolation of penetrated tanks; possible tank lightering, etc.);

AMSA, as vessel-based marine oil spill Control Agency in Commonwealth marine waters activates the National Plan for Marine Environmental Emergencies (NATPLAN) (2014) to respond to oil spill threats. AMSA will determine the appropriate response strategy for the spill type, location and environmental sensitivities which are threatened via a Net Environmental Benefits Assessment (NEBA).

All vessels are required to undertake routine SMPEP testing/drills to ensure all crew are trained in the response requirements. The SMPEP is routinely reviewed and updated such that the document remains relevant and current.

AMSA in Commonwealth waters are the responsible agencies for operational monitoring. Upstream PS/Cooper will provide support where necessary and implement scientific monitoring appropriate the nature and scale of the spill.

Likelihood of Vessel Collision with resultant spill:

DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m^3) for offshore vessels caused by collisions or fuel transfers. Likelihood of a significant MDO spill is extremely unlikely.

The residual risk of a significant MDO spill event is assessed as low.

6.16.4 Environmental Risk and Control Measure Summary

Aspect	MDO Spill
Impact summary:	Degradation of water quality. Toxic effects to the marine environment including marine fauna; Tainting to commercial fish catch.
Extent of impact:	EMBA expected to extend NE-SW from the spill site to approximately 73km around the release point.
Duration of impact:	Short-term and recoverable
Level of Certainty of Impact:	HIGH. Spill source volumes are limited in size, the environmental impact of MDO is well understood, significant spill volume has been modelled and a very conservative threshold has been selected to define the EMBA.
Uncertainty: Impact Decision Framework	B. Vessel spills are planned for and process is well understood, it is not new to the area and good practice is well defined. *ALARP demonstrated through use of probabilistic modelling has been performed to assess potential impacts*.

Control measures to be implemented to control this hazard and prevent or mitigate spills to the marine environment are:

- *Fuel selection*: Fuel use on-board is marine diesel;
- *Refuelling*: No refuelling will be undertaken at sea;
- *Vessel selection*: The vessel selected for IMR activities will meet:
  - Class certification requirements under the Navigation Act 2012 (as required);
  - Relevant crew shall hold valid STCW certificates (or equivalent to class);
  - Marine Inspection for Small Workboats IMCA audit shows vessel safety and integrity requirements are met;
  - All EP commitments for vessels.
- *SMPEP Implementation (Source Control):* Vessels have a current approved current SMPEP (or equivalent appropriate to class) implemented in a spill event to prevent/limit spill discharge to the environment;

- *SMPEP Crew Induction (Source Control):* Vessel crew members are inducted and trained into vessel spill response procedures to ensure SMPEP is implemented;
- *Vessel SMPEP Exercises/Drills (Source Control):* Vessel implements routine emergency exercises (including spills) as part of its drills matrix;
- *OPEP Exercise*: Prior to IMR activities an oil spill response exercise will be conducted to test interfaces between the SMPEP, OPEP and NATPLAN;
- *Spill Reporting*: Cooper will report the spill to regulatory authorities within 2 hours of becoming aware of the spill;
- *OPEP Implementation*: The BMG OPEP is implemented in response to a spill during IMR activities;
- *Operational & Scientific Monitoring (OSMP) Implementation*: Upstream PS/Cooper will undertake operational and scientific monitoring in accordance with the Cooper OSMP to support the spill response and collect scientific monitoring data to characterise environmental impacts.

Note that the control measures identified for preventing spatial conflicts with commercial fishing and shipping contained in Section 6.10 are also relevant to controlling this hazard.

7 Environmental Performance Monitoring

7.1 Implementation

Cooper/Upstream PS manages the environmental impacts and risks associated with the BMG NPP activity to ALARP and acceptable levels through the implementation of the Upstream PS Integrated Management System (IMS). The IMS is a formal and consistent framework for all activities performed by Upstream PS and contracted resources.

The BMG NPP EP details a number of Environmental Performance Outcomes (EPOs) and Environmental Performance Standards (EPSs) for the BMG NPP activity. To achieve these performance outcomes, the EP's implementation strategy incorporates the following key IMS processes:

- Position definition (roles and responsibilities);
- Training and awareness (Inductions, competency and training requirements);
- Emergency response (planning, testing, training and competency);
- Communications (workforce participation, communication forums);
- Contractor and supplier management (pre-qualification assessment, assurance audits);
- Impact and risk management (campaign-specific risk assessments, job hazard assessments);
- Operational Controls (permit-to-work, management of change, chemical selection and use);
- Performance Reporting (operational reports, annual reports, incident reporting, emissions monitoring);
- Audit and inspection; and
- Management of non-conformance.

Key roles within the Cooper/Upstream PS organisation structure are allocated responsibility for the implementation or compliance monitoring of EP commitments. All Cooper/Upstream PS positions have position descriptions which delineate the necessary qualifications, experience and skill levels required to undertake the role together with the HSEQ responsibilities of the position. All contractors engaged on BMG NPP activities undergo prequalification prior to contract award to ensure they have equivalent resource management systems to ensure personnel competencies and training.

A key implementation activity is the induction of offshore personnel in a campaign-specific induction prior to activity commencement to ensure personnel understand the environmental requirements of the activity EP and key personnel with specific responsibilities in the EP are aware of their responsibilities.

7.2 Ongoing Monitoring of Environmental Performance

Environmental performance is monitored via a range of management system processes as detailed below.

7.2.1 Contractor and Supplier Management

7.2.1.1 General

Upstream PS's systems provide for the assessment of contractors to ensure that all contractors perform work in a healthy, safe and environmentally sound manner in line with Upstream PS's requirements. All major contractors involved with the BMG Field Facilities will be assessed according to the Upstream PS Contractor HSEQ Evaluation Procedure[16]. This procedure details the requirements for contractor selection, before contract award, to ensure Contractors have the necessary competencies and documentation to perform the nominated work safely and in accordance with all Upstream PS Policies, objectives, procedures, statutory requirements and standards. Contractors are selected based upon an assessment of their ability to:

- Comply with statutory requirements and Upstream PS Standards;
- Provide Project HSE objectives, programs, appropriate training and performance monitoring;
- Work in accordance with a Safety Management System (SMS) which is acceptable to, and compatible with, the Upstream PS Management System Standards;
- An acceptable HSE performance record;
- Provide appropriate resources and competency in the required services;
- The services and hardware comply with the requirements of the accepted EP; and
- Any equipment to be used in the service meets all regulatory requirements, is fit-for-purpose and meets Upstream PS Standards (includes provision for all certificates, testing and verification).

The procedure also requires Upstream PS to ensure compliance by undertaking periodic contractor audits with respect to their competency, HSE Performance and compliance with Upstream PS requirements.

Upstream PS, in accordance with this Contractor Selection Procedure assesses contractors to be engaged on the BMG Facilities for their HSE Management System coverage, relevant operational procedures and HSE performance. Accordingly, Upstream PS will review and approve sub-contractor systems and procedures, which are of an equivalent standard (minimum requirement) to Upstream PS requirements for use on assets for particular activities.

7.2.1.2 Campaign-specific Vessel Compliance

Upstream PS/Cooper Energy, as part of contractor pre-qualification and selection, assess vessel compliance with the requirements of this EP via the BMG Environment Plan – Vessel Contractor Compliance Checklist. This covers aspects including, but not limited to:

- Vessel pollution control equipment;
- Assessment of IMS (international vessels);
- Vessel lighting and navigation equipment;
- Crew competencies and training; and
- Emergency/oil spill response.

For vessels mobilising from international ports or ports outside the IMCRA Twofold Shelf bioregion, as part of the prequalification process, contractors will be required to undertake an IMS risk assessment[17] supplying relevant supporting documentation to Cooper/Upstream PS to validate the IMP risk status. Assessment parameters include:

[16] The Cooper HSE Contractor Prequalification Procedure used for Cooper-engaged contractors, which has been assessed as equivalent to the Upstream PS Contractor Selection Procedure, It may be utilised by Upstream PS to avoid duplicating assessment processes. Where necessary Upstream PS will duplicate processes to ensure Upstream PS requirements are being met.

[17] Current best practice is the Biofouling Risk Assessment tool currently managed by the WA Department of Fisheries. This assessment criteria will be monitored and updated as necessary.

- Vessel type;
- Vessel activity location in Australia;
- Presence and age of anti-fouling control coating;
- Vessel IMS inspection, cleaning and treatment history (including in-water and dry dock cleaning details);
- Vessel seawater water system treatment history;
- Vessel location and movement history (infection risk since antifouling coating application or verified IMS inspection); and
- Location and duration of the planned activity within 12 nm of coastline.

For vessels which can demonstrate via the risk assessment methodology that the IMS risk is low and acceptable without any further corrective actions, the vessel will be deemed suitable for use in BMG IMR activities with respect to IMS risk.

For vessels where IMS risk is assessed as medium or high, the vessel will require an inspection via a qualified independent third party marine pest inspector to assess and determine the corrective actions required to reduce the vessel to a low IMS risk. The contractor will demonstrate implementation of these corrective actions prior to vessel mobilisation to Australian or Twofold shelf waters. Corrective actions may include vessel dry-dock and cleaning, limiting vessel entry into waters less than 50m water depths or 12 nm from the Australian coastline, or limiting time within shallow water environments.

7.2.2 Impact and Risk Management

The key to the management of risk throughout all Upstream PS operations is the systematic identification of hazards and the assessment and management of the risk associated with these hazards. The aim of the hazard identification and assessment process is to prevent or minimise the likelihood of a hazardous event occurring during operation of the facility to ALARP. Where a hazard is identified, the environmental impact or risk is assessed.

The BMG NPP activity has, by virtue of this EP revision, undergone a review of the environmental impacts and risks associated with the BMG NPP activity. The process of impact and risk assessment/management will continue throughout the life of the NPP activities by using risk assessment techniques such as Hazard and Operability Studies, Hazard Identification Studies and Job Hazard Analyses (JHAs) depending on the level of change or task being considered. Activities which may trigger an impact or risk assessment include:

- As part of a JHA prior to completion of a work permit;
- In an incident assessment;
- As part of planning for introduction of new activity, major equipment or method of operation;
- As part of planning for a substantial change to existing equipment or method of operation; and
- Other management of change activities (e.g. chemical change, organisation change, etc.).

For IMR activities a campaign-specific risk assessment will be undertaken, considering all impacts which might arise from the proposed scope of works prior to the works to ensure that impacts and risks are managed to ALARP and acceptable levels.

7.2.3 Management of Change

Upstream PS corporate processes are in place to manage both temporary and permanent changes covering the BMG Field organisation, procedures, engineering, facilities and materials.

During the life time of the facility, there may be occasions where modifications to BMG Field equipment or a new activity is required. 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/risk previously; and
    - Authorised in the existing management plans, procedures, work instructions or maintenance plans.
- Proposed changes to activities, assets, equipment, processes or procedures that have the potential to impact on the environment or interface with an environmental receptor; and
- Changes to the requirements of an existing external approval (e.g. changes to conditions of environmental licences or accepted plans).

A risk assessment will accompany any MOC which has an environmental impact or carries an environmental risk and will be undertaken in accordance with the Upstream PS Risk Management Standards. The risk assessment will consider the impact of the proposed change on environment impacts/risks. In the event that the proposed change introduces a significant new environmental impact or risk; results in a significant increase to an existing impact or risk; or has a cumulative effect from a series of changes which result in a significant increase in environmental risk, this EP will be revised for re-submission to NOPSEMA.

Additional controls identified as part of the change event shall be effective in reducing the environmental impact and risk to a level which is ALARP and acceptable; and meets the nominated EPOs and EPSs set out in the accepted EP for the activity. The risk assessment will also consider the impact of the proposed change on the EPOs defined in this EP.

Note *EPOs and EPSs cannot be altered from those set out in the accepted EP. If EPOs/EPSs cannot be met a recordable or reportable incident must be registered for the activity.*

All environmental risk assessments must include an ALARP and acceptability assessment against the Cooper criteria.

Note for changes to the accepted EP, all changes will be traceable via ‘track-changes’ within the revision document and any changes made fully justified. Broadly, amendments to documents can be made to address minor errors in fact that do not trigger a formal revision of the EP.

7.2.4 Internal Reporting

7.2.4.1 Performance Reporting

Routine internal performance reporting of HSE matters for IMR activities includes the following:

- Daily IMR operations reports: The Cooper/Upstream PS Site Representative (for vessel-based activities) will prepare a daily operations report, including data on activities conducted for the day and any HSE issues arising. This will be issued to the BMG Operations Manager daily;
- Environmental performance report: Cooper/Upstream PS will prepare an annual EP performance report detailing the outcomes of each performance standard in the EP. This will be submitted to NOPSEMA within 3 months of the end of the reporting year.

7.2.4.2 Incident Recording and Reporting

All environmental incidents[18], including near misses and stakeholder complaints are recorded and investigated in accordance with the Upstream PS Incident Investigation Procedure. An incident reporting and corrective actions database is in place which records all incidents and the resulting corrective actions for BMG Field incidents. Corrective actions are managed in accordance with the Registering and Close-out of Corrective Actions Procedure and logged in the database. All Upstream PS personnel are trained in the use of the incident database. Corrective and preventative actions taken to eliminate the cause of potential incidents will be commensurate with the magnitude of the environmental risks.

The Upstream PS HSEQ Coordinator ensures all HSE incidents are recorded in the database, and incident investigation and action close-outs undertaken.

The results of incidents and associated investigations will be communicated at HSE Meetings and corrective actions monitored to close-out.

The BMG Site Hazard and Risk Register (HRR) and the management system are reviewed following incidents to ensure that controls are in place to prevent recurrence. This may be reinforced at inductions, toolbox meetings and HSEC meetings (as appropriate).

All Cooper/Upstream PS personnel report any environmental incidents associated with BMG to the Upstream PS BMG Operations Manager. The Cooper General Manager Operations will notify NOPSEMA of any reportable incidents associated with the activity.

7.2.5 Environmental Performance Monitoring and Reporting

7.2.5.1 Emissions Monitoring

Upstream PS will maintain a quantitative record of emissions and discharges from NPP activities. A summary of these results will be reported in the annual EP performance report submitted to NOPSEMA. Copies of emission and discharge records will be retained in the Upstream PS document management system.

7.2.5.2 Operational and Scientific Monitoring Plan

Level 2⁺ Spill Monitoring:

The Cooper Energy Offshore Victoria Operational and Scientific Monitoring Program (OSMP) contains detail regarding the triggers for commencing operational and scientific monitoring, who will conduct the monitoring and what will be monitored. This document supports the BMG NPP OPEP, the NPP spill risk and its associated EMBA and the sensitivities affected. Cooper/Upstream PS have engaged scientific support contractors to assist with the implementation of the OSMP.

Roles and responsibilities for maintaining operational and scientific monitoring capability is the responsibility of the Cooper General Manager Operations. Roles relating to the implementation of the Offshore Victoria OSMP are contained within the individual implementation plans which support that document.

Level 1 Spill Monitoring:

A ‘continuous gas’ level 1 spill from the BMG NPP infrastructure will result in monitoring. In the event that analytical results triggers water quality criteria for fish tainting, or visible sheens are observed, the release will be considered as a level 2 spill and operational and scientific monitoring, as required under the Cooper Energy Offshore Victoria OSMP will be implemented.

[18] This is defined as any non-compliance with EP EPOs or EPSs.

7.2.5.3 Audit and Inspection

Vessels:

Vessel-based IMR activities will be inspected, audited and reviewed for environmental performance at the following points in the activity:

- The Upstream PS/Cooper contractor selection process will review the specifications of any engaged vessel against the criteria detailed in the accepted EP for acceptability;
- A due-diligence pre-activity inspection/audit of the IMR vessel will be carried out prior to the work commencing (and after contract award) to verify that procedures and equipment for managing routine discharges and emissions are in place to ensure compliance with the EP;
- During IMR activities, the Cooper/Upstream PS Representative on-board will be responsible for undertaking inspection activities as part of the campaign-specific HSE Management Plan. This will include verifying vessel activities are in compliance with the EP. Inspection using an environmental checklist will be completed and issued to the BMG Operations Manager for review during the activity to confirm that EPOs and EPSs are being achieved.

A summary of the EP commitments for the activity will be distributed aboard the vessel.

Any non-compliance with the environmental performance standards outlined in this EP will be subject to investigation and follow-up action as detailed in Section 7.2.4.2 of this EP Summary.

The findings and recommendations of inspections and audits will be documented and distributed to relevant personnel for comments. Any opportunities for improvement or non-compliances noted will be communicated to all relevant personnel at the time of the inspection/audit to ensure adequate time to implement corrective actions. The audit findings will be documented in a formal audit report.

Results from the environmental inspections and audits will be summarised in the annual EP performance report submitted to NOPSEMA

7.2.5.4 Management of non-conformance

Non-conformance, corrective preventative and improvement actions are managed in accordance with the Registering and Close-out of Corrective Actions Procedure. This utilises the database system for stewardship of corrective actions (as per incident reporting).

7.2.5.5 Management Review

Upstream PS senior management review the performance of the Upstream PS HSEQ Management system at planned intervals to ensure its continuing suitability, adequacy and effectiveness in accordance with the HSEQ Management Review Procedure. This review includes assessing opportunities for improvement and the need for changes to the management system, including policies and objectives. Management reviews are conducted on a bi-annual basis and corrective/improvement actions posted in the database system for stewardship of corrective actions (as per incident reporting).

8 Oil Pollution Emergency Plan

8.1 Overview

8.1.1 General

The BMG NPP Oil Pollution Emergency Plan (OPEP) is Cooper/Upstream PS's response strategy in the event of a hydrocarbon spill during NPP activities. The OPEP has been accepted by NOPSEMA as compliant with the OPGGSER.

Cooper/Upstream PS has reviewed the oil spill risks, hydrocarbon types and spill impact results which may occur as part of NPP activities. Oil spill response options have been assessed for their suitability and effectiveness in reducing oil spill impacts to ALARP.

Cooper/Upstream PS have utilised a Net Environmental Benefit Assessment (NEBA) methodology to identify the appropriate response strategies for hydrocarbon spill scenarios possible during the BMG NPP activities. A planning NEBA was conducted to determine the spill response strategies considered viable and expected to offer net benefit to sensitivities within the EMBA.

Given the rapid evaporation/volatilisation of hydrocarbons when released, the rapid spreading rate of MDO, and no shoreline residues predicted for any of the spill risks identified, the primary response strategy will be to:

- Initiate source control:
  - For vessels, this includes the implementation of SMPEP actions to reduce the leak;
  - For BMG infrastructure this would include:
    - An assessment of the leak (including water quality for continuous leaks) and validation monitoring;
    - Engineering assessment of practicable source control options recognising the low level spill potential for this infrastructure. Options may include:
      - Vessel-based intervention via a work-class ROV; or
      - For small leaks not increasing in flowrate, not presenting an escalation risk and meeting ALARP and acceptability criteria, continued monitoring.
- Monitor and evaluate the spill via aerial and marine surveillance, oil spill trajectory modelling, oil spill tracking buoys (for IMR vessel spills).

Additional secondary measures to protect specific environmental sensitivities within the spill response EMBA which may offer net benefit (MDO spill only) includes oiled wildlife response where oiled wildlife is observed.

In the event of an actual spill, an operational NEBA will be undertaken to review and verify the response option and assess for additional factors which may effected the implementation of these options.

8.1.2 Oil Spill Response – Assessment of Impacts and Risks

8.1.2.1 Source Control

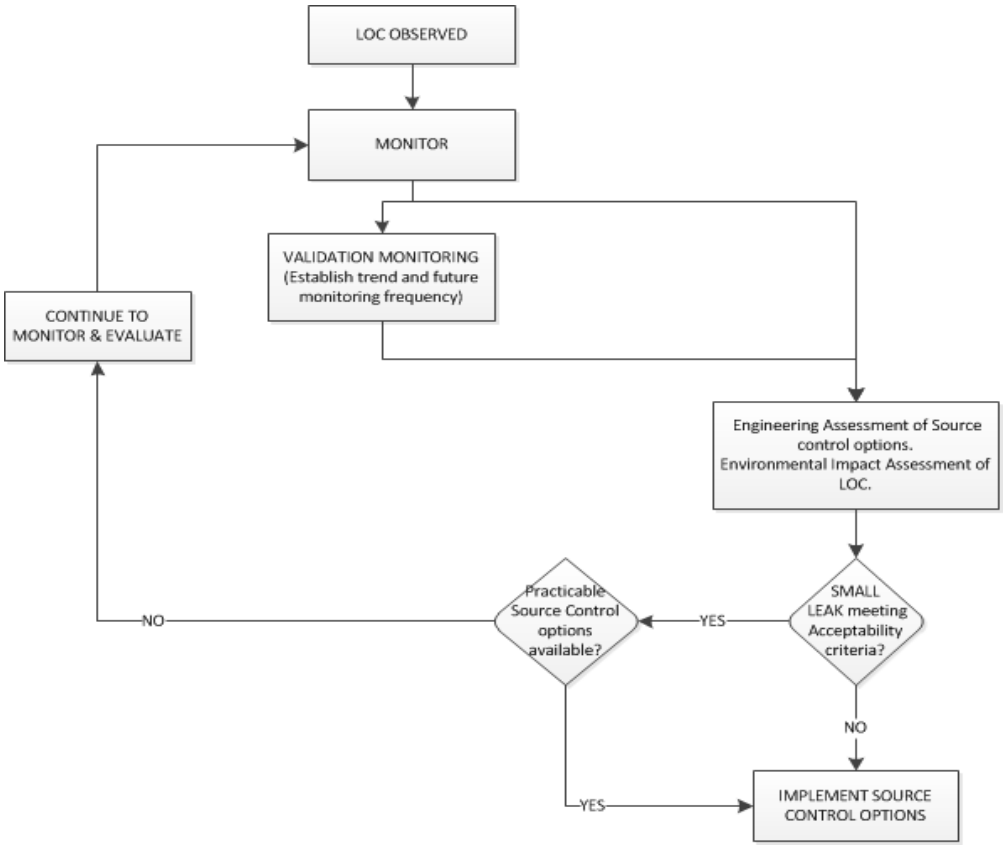
Overview of Activity:

Vessel Spills: Source control activities are described and assessed in Section 6.16.

BMG Infrastructure Spills: Infrastructure releases from the BMG subsea facilities are driven by equipment failure 'incidents' and gas leakage through barrier valves from the BMG wells. A Level 1 gas/condensate release, given the tested well barriers, is considered the maximum credible release volume predicted from the facilities given the threats present at the location. Source control options assessed for these release volumes determined vessel-based work-class ROV intervention as a practicable source control option for the BMG facilities during NPP.

The methodology adopted for assessing any BMG infrastructure loss of containment, its environmental impact and establishing corrective actions (i.e. source control) is provided in Figure 8-1.

Figure 8-1: Assessment Methodology for Source Control Evaluation



This includes the following assessment stages:

- On discovery of a BMG infrastructure LOC the following leak parameters are obtained:
  - The release location, the escalation potential given the location, an estimate of the release rate and the release appearance (e.g. gas, condensate, oil);
  - Water quality is sampled as close as possible (~ 0.5 to 1m) to the release point, at 2 and 5 m of the release if the release is continuous (i.e. not discrete bubbles). Background water sampling will also be undertaken. This information is utilised in the engineering assessment process to determine the leak origin and baseline leak conditions;

- Validation monitoring will be undertaken, typically 2-6 weeks after initial leak observation, to verify the leak source conditions and appearance, the leak trend (increasing, decreasing or unchanged) and additional water analyses obtained.
- The Upstream PS Engineering Assessment Procedure utilising monitoring information will identify practicable control options to eliminate or mitigate the LOC source. An EIA, informed by the water quality monitoring data (if a continuous leak) will establish the environmental impact. Practicable source control options will be assessed for leak elimination/reduction effectiveness, the residual environmental impact with source control implemented and an ALARP and acceptability assessment.

For small leaks it is possible that no practicable source control option can be identified or by implementing source control this may lead to an increased risk of damage to BMG equipment (and associated leak rates to the environment). Accordingly, small leaks which are not increasing in flowrate; do not have an escalation risk; and meet the following criteria will be considered ALARP and acceptable:

- An effective and practicable source control option cannot be identified through the assessment methodology in Figure 8-1;
- The leak does not present a significant impact to the Commonwealth marine environment in accordance with 'significance criteria' listed in the EPBC Act - Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (DoE, 2013);
- For continuous leaks, analytical results from water testing meet water quality 'trigger' criteria[19] for hydrocarbons (99% species protection) as listed in the Australian and New Zealand Guidelines for Fresh and Marine Waters (ANZECC, 2000) (considering background concentrations) within 5 m of the leak source representing a negligible environmental impact[20];
- Stakeholder concerns (objections and claims) have been assessed for merit and a stakeholder response has been provided which resolves the objection or claim (as far as practicable); and
- ESD requirements are met (i.e. no potential for serious/irreversible environmental damage or threats to biological diversity and ecological integrity).

For such cases continued monitoring to verify changes in release rates and the associated environmental impact will be undertaken at a routine frequency determined by the Engineering Assessment Procedure.

Hazard:

The following activities have the potential to interfere with environmental sensitivities at the BMG location:

- ROV activities; and
- Vessel activities.

[19] Note these are 'trigger' values within the whole Australian marine environment context. ANZECC (2000) provides protocols and detailed advice to adapt and tailor guideline 'trigger' values to environmental sensitivities on a local/regional context based upon the type of water resource and inherent differences in water quality across the region. Cooper Energy/Upstream PS may initiate further investigation into trigger thresholds and establish local/regional values in accordance with ANZECC (2000) guidance which may be used as substitute 'trigger' values in this assessment.

[20] Note this water level criteria (99% species protection) meets appropriate water quality to protect threatened species in the area which are under conservation management plans/conservation advices with marine pollution listed as a potential threat.

Known and Potential Impacts:

All known and potential impacts and risks from ROV and vessel-based activities have been previously identified in the body of this EP. No additional impacts or risks are identified for source control activity.

Assessment of Impacts and Risks:

No additional impacts or risks are identified for source control activity.

Environmental Risk and Control Measure Summary

Refer to impacts and risks assessed in Section 6.1 to Section 6.16 of this EP Summary.

8.1.2.2 Monitor and Evaluate

Overview of Activity:

Ongoing monitoring and evaluation of the oil spill is a key strategy, critical for maintaining situational awareness and to complement and support the success of other response activities. It is the responsibility of the Control Agency (CA) to undertake operational monitoring during the spill event to inform the operational response. Effective monitoring for oil spills at the BMG NPP assets includes the following:

- Aerial observation;
- Vector analysis (manual calculation);
- Oil Spill Trajectory Modelling; and
- Utilisation of satellite tracking drifter buoys.

For vessel-based spills the responsibility for operational monitoring lies with AMSA (Commonwealth waters), however Upstream PS/Cooper will support AMSA's response to an IMR vessel MDO spill at the BMG location.

Hazard:

The following activities associated with operational monitoring have the potential to interfere with marine fauna:

- Aircraft use for aerial surveillance.

Known and Potential Impacts:

The known and potential impacts of vessel and aircraft (helicopter or fixed wing) noise in the environment are:

- Potential behavioural impacts/damage to whale and pinniped species; and
- Disruption to shoreline bird species.

Assessment of Impacts and Risks:

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson et al., 1995). Sound emitted from helicopter operations is typically below 500 Hz and sound pressure in the water directly below a helicopter is greatest at the surface but diminishes quickly with depth. Reports for a Bell 214ST (stated to be one of the noisiest) identify that noise is audible in the air for 4 minutes before the helicopter passed over underwater hydrophones. The helicopter was audible underwater for only 38s at 3 m depth and 11s at 8 m depth (Green 1985a; cited in Richardson et al, 1995).

Sound levels from helicopters are not expected to cause physical damage to marine fauna, however temporary behavioural changes (avoidance) in species (cetaceans, turtles, fish) may be observed.

The behavioural reaction of cetaceans to circling aircraft (fixed wing or helicopter) is sometimes conspicuous if the aircraft is below an altitude of 300m, uncommon at 460m and generally undetectable at 600m (NMFS, 2001; cited in Santos 2004; Richardson et al, 1995). Baleen whales sometimes dive or turn away during over-flights, but sensitivity seems to vary depending on the activity of the animals. The effect on whales seems transient, and occasional over-flights probably have no long-term consequences (NMFS, 2001; cited in Santos, 2004).

Richardson et al. (1995) identifies for Californian sea lions (an Octariid similar to fur seals) the following behaviours to flight sound:

- Jets above an altitude of 305 m produced no reaction and below that height caused limited movement but no major reaction;
- Light aircraft directly overhead at altitudes of < 150-180 m elicited alert reactions and in sea lions movement;
- Helicopters above 305 m usually caused no observable response while those below caused the pinnipeds to raise their heads, often causing some movement and occasionally caused rushes by some animals into the water.

Aircraft for safety reasons do not fly low enough to disturb nesting fauna (e.g. birds) (negligible consequence).

Aerial surveillance platforms will operate at between 300 – 500 m altitudes when undertaking observation activities. In accordance with the EPBC Regulations (Part 8) a fixed wing aircraft will maintain a buffer of 300 m from a cetacean and a helicopter will maintain 500m from a cetacean. Note that any noise produced by surveillance aircraft is localised and temporary as the aircraft is in constant movement. On this basis impact to cetaceans, pinnipeds or shoreline bird species is expected to be temporary, localised and recoverable (minor consequence).

Environmental Impact and Control Measure Summary:

Aspect:	Spill Response – Operational Monitoring
Impact summary:	Impact to marine fauna due to aircraft surveillance and operational monitoring activity.
Extent of impact:	Localized (immediately around vessel or aircraft).
Duration of impact:	Temporary (duration of surveillance) and recoverable
Level of Certainty of Impact:	HIGH: Impacts from sound disturbance to marine fauna is well understood and controls documented in legislation.
Uncertainty: Impact Decision Framework	**A**: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement.

Control measures to be implemented to control this hazard and prevent disturbance, damage or disruption to whales and pinniped species are:

- *Fauna Buffer Distances – Aircraft*: Surveillance aircraft maintain buffer distances to fauna to prevent disturbance. This includes for helicopters a buffer distance of 500 m and for fixed wing a buffer distance of 300 m in accordance with the *Environment Protection and Biodiversity Conservation Regulations 2000* (Part 8).

8.1.2.3 Oiled Wildlife Response

Overview of Activity:

In the event of a spill, wildlife impacts on wildlife are determined by the fauna present, the type of oil spilt and the extent of exposure.

No shoreline impacts are predicted from BMG NPP spill risks therefore adjacent shorelines which contain threatened shorebird habitats are not expected to be affected.

Threatened seabirds in the EMBA are predominantly petrel, shearwater and albatross species which are widespread and oceanic. While the BMG area is located in biologically important areas (BIAs) for many albatross species (foraging), given their method of foraging (aerial diving), exposure of these species to surface hydrocarbons sufficient to cause mortality impacts is considered unlikely. The probability of exposure is reduced further given the temporary timeframes (~3 hrs) and limited sea surface area (~6 km^2) where sea surface thicknesses exceed ecological thresholds (10µm). On this basis it is unlikely that a large number of seabirds will be impacted by sea surface residues. Individual birds may be affected and may make their way to adjacent shorelines.

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

- Primary Response: Situational understanding of the species/populations potentially affected (ground-truth species presence and distribution by aerial observations);
- Secondary Response: Deterrence or displacement strategies (e.g. hazing by auditory bird scarers, visual flags or balloons, barricade fences; or pre-emptive capture which involved a DELWP wildlife response, capture of wildlife and transfer or holding while the contamination threat remains) (*unlikely to be required*); and
- Tertiary: Capturing, field stabilisation, transport, veterinary examination, triage, stabilisation, cleaning, rehabilitation and release. Because of the light nature of the oil, its rapid weathering and evaporation, and no shoreline exposure oiling wildlife impacts are expected to be very low (if any) and therefore tertiary response would be likely (at most) for a handful of birds.

Hazard:

The hazards associated with oiled wildlife response (OWR) are:

- Hazing of target fauna may deter non-target species from their normal activities (resting, feeding, breeding, etc.); and
- Inappropriate handling and treatment of target fauna.

Known and Potential Impacts:

The known and potential impacts of this activity are disturbance, injury or death of fauna (moderate consequence).

Assessment of Impacts and Risks:

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. To prevent these impacts only DELWP trained oiled wildlife responders will approach or handle any fauna. This will eliminate any handling impacts to fauna from Upstream PS/Cooper personnel and reduce the potential for distress, injury or death of a species (low residual risk).

Environmental Risk and Control Measure Summary:

Aspect:	Response – Oiled wildlife response
Impact summary:	Disturbance, injury or death to shoreline bird species through inappropriate handling, proximity, etc.
Extent of impact:	Localized and low level residues expected at identified shoreline bird nesting areas.
Duration of impact:	Temporary (several days)
Level of Certainty of Impact:	**HIGH:** Impacts from oil to shoreline bird species has been extensively studied. Wildlife capture and rehabilitation techniques are documented and adopted by trained DELWP personnel (if required).
Uncertainty: Impact Decision Framework	**A**: Part of State Response Planning and to trained DELWP personnel - Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control this hazard and prevent disturbance, injury or death to fauna associated with OWR are:

- *Upstream PS/Cooper Inductions*: Oiled wildlife is only approached or handled by DELWP trained oiled wildlife responders. Upstream PS/Cooper personnel are advised of wildlife interaction restrictions through site safety inductions.

8.2 Oil Spill Response Arrangements

Cooper/Upstream PS have the following oil spill response arrangements in place:

- Associate membership (standing agreement and service contract) with the Australian Marine Oil Spill Centre (AMOSC) for the supply of experienced personnel, equipment and oil spill trajectory modelling services;
- Memorandum of Understanding with the Australian Maritime Safety Authority (AMSA) as managers of the National Plan for Maritime Environmental Emergencies, will support and supply Cooper/Upstream PS with response equipment from national stockpiles and trained personnel;
- A service agreement with GHD to provide specialist resources for scientific monitoring, analytical services, scientific monitoring vessels and sampling equipment;
- Contract pre-qualification with Bairnsdale Air Charters for provision of surveillance aircraft and pilots; and
- Marine vessel support via contract with Comchart marine.

8.3 Preparedness

8.3.1 Emergency Response

BMG NPP activities operate under an Emergency Response Plan (ERP) to ensure timely response and effective management of any emergency. Should any emergency incidents arise which result in a loss of containment of hydrocarbons, the response to the spill will be managed by the BMG NPP OPEP.

During IMR activities, general vessel emergencies are handled under the contract vessel's Emergency Response Procedures which are supported by the contractor vessel's Shore-side Emergency Management System. The Upstream PS Emergency Response Group (ERG) provides shore-side support to the contract vessel as necessary in the event of an emergency. This information is detailed in the project-specific interface documentation for IMR activities.

Vessel activities will also operate under the vessel's SMPEP (as appropriate) or approved spill clean-up procedures/equipment by qualified personnel to ensure timely response and effective management of any vessel-sourced oil spills. The SMPEP (or equivalent appropriate to class) is routinely tested and exercise drills are conducted regularly. The SMPEP is designed to ensure a rapid and appropriate response to any oil spill and provides guidance on practical information that is required to undertake a rapid and effective response; and reporting procedures in the event of a spill.

8.3.2 Training

Key Cooper/Upstream PS and vessel roles are identified within the BMG OPEP. These positions have position descriptions for operational/emergency roles which outline the necessary qualifications, experience and skill levels required to undertake the role.

All contractors engaged on BMG NPP activities have equivalent resource management systems to ensure equivalent levels of personnel competency and training.

All vessel personnel have full inductions into the BMG NPP EP/OPEP requirements prior to the commencement of vessel activities.

8.4 Testing of Response Arrangements

To ensure readiness oil spill response exercises are conducted prior to the commencement of an IMR campaign, when the oil spill response arrangements are significantly altered or at least, on an annual basis.

Arrangements for testing response arrangements include:

- Defined test objectives;
- Measurable performance outcomes for each of the test objectives and the performance standards to be achieved; and
- Mechanisms to identify, address, document and track to completion corrective actions arising from response exercises.

Where changes are required to the OPEP resulting from exercise outcomes the Upstream PS Operations Manager is responsible for ensuring changes are assessed against OPGGSER regulatory revision criteria and where necessary, the EP/OPEP is revised and submitted to NOPSEMA as a formal revision.

9 Consultation

Cooper has consulted with stakeholders in the preparation of the BMG NPP EP revision. Cooper has established contacts and working relationships with key stakeholder groups that have functions, interest or activities in the BMG area through previous survey activities which have undertaken on BMG assets.

9.1 Stakeholders

Table 9-1 provides details of the relevant stakeholders contacted in the preparation of this EP Revision.

Table 9-1: Relevant Stakeholders

Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
National Offshore Petroleum Titles Administrator (NOPTA)	Australian Fisheries Management Authority (AFMA)
Australian Maritime Safety Authority (AMSA)	Department of Innovation, Industry and Science (DIIS)
Maritime Border Command (MBC)	Department of Defence (DoD)
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	Australian Hydrological Service (AHS)
Department of Agriculture and Water Resources (DAWR)	
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 – Earth Resources Regulation (ERR)	Department of Environment Land Water and Planning (DELWP) Oiled Wildlife Response
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:	
Commonwealth Fisheries Association (CFA)	South-east Fishing Trawl Industry Association (SETFIA)
Seafood Industry Victoria (SIV)	Lakes Entrance Fisherman's Cooperative Limited (LEFCOL)
Victorian Recreational Fishers Association (VRFish)	Sustainable Shark Fishing Inc. (SSF)
Oil Spill preparedness and response agencies:	
Australian Marine Oil Spill Centre (AMOSC)	GHD (Scientific Monitoring Resource)
Bairnsdale Air Charter (Oil Spill Aviation Support)	Comchart Marine (Oil Spill Marine Support)
Nearby Titleholders:	
Esso Australia Resources Pty Ltd	Seven Group Holdings
Bass Strait Oil Company Limited	
Any other person or organisation that the Titleholder considers relevant	
None Identified (given distance from shore)	

9.2 Consultation (EP Revision)

Stakeholders identified in Table 9-1 were engaged during the EP Revision. Engagement includes a combination of email exchanges with relevant persons and a phone conversation with SETFIA. No concerns or objections have been raised with regard to the continued NPP of the BMG assets. Cooper believes that the low rate of feedback (i.e., replies to initial and follow up emails and return phone calls) and the low level of concern from stakeholders expressed to date is due to the fact that the asset has been in existence for a number of years without any major incidents; and stakeholders have a level of familiarity with Cooper through previous stakeholder interaction via the IMR activities undertaken at BMG by Cooper since 2012.

For those stakeholders which responded, the key theme emerging was that Cooper maintains ongoing engagement and conversation on future activities.

A stakeholder consultation summary undertaken to date, together with Cooper/Upstream PS's responses and assessment of merits and feedback is included in Table 9-2. This table focuses on stakeholders who have been identified as 'relevant persons' whose functions, interests or actives may be affected by the assets' operations. It also includes key stakeholders with whom engagement has taken place to enable Cooper/Upstream PS to determine whether they are 'relevant persons' for the NPP activity.

9.3 Ongoing Consultation

9.3.1 Ongoing Engagement

Cooper/Upstream PS has developed and maintains a register of commercial fishers in the Gippsland Basin via stakeholder engagement initiatives and inspection activities related to the BMG Field via ongoing liaison with commercial fishing cooperatives and association members. However to ensure broader communications relevant to new commercial fishers, Cooper has sought the support of existing stakeholders to identify new stakeholders (e.g. new fishing vessel masters, new fishing vessels, etc.). This is an ongoing review process which is held at regular intervals to ensure all vessels fishing in proximity to the BMG Field are aware of the infrastructure through fishing plotter upgrades.

Cooper/Upstream PS updates 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 capture of any new vessel masters, new fishing vessels or any increases in fishing activities due to fishery closures. Cooper maintains a register of fishing vessels and the currency of vessel 'plotter information' is regularly maintained.

During NPP field activity, the Gippsland fishing fleet are provided with SMS information via SETFIA to ensure they are aware of IMR activities.

Cooper expects additional stakeholders not currently identified in this EP may be affected, and that these stakeholders may only become known to Cooper through on-going engagement and consultation carried forward. These stakeholders, if identified, will be included in the stakeholder register for BMG.

COE Website:

Project information has been made available on the Cooper website (http://www.cooperenergy.com.au/) for all interested members of the public to access. Flyers prepared for future project milestones (e.g. scopes outside this EP such as the Sole Development) will also be made available on the website.

9.3.2 Consultation Triggers

Stakeholder consultation will be ongoing during the BMG NPP. Key milestones that will trigger further consultation include:

- EP acceptance and the availability of the EP Summary on the NOPSEMA website;
- IMR activity;
- Any significant incidents (e.g., large hydrocarbon spill);
- Any minor leaks identified during equipment monitoring events;
- Future optimisation activities (e.g., bringing assets back into production, future development activities);
- When a decision is made to decommission the assets.

Any claims or objections from stakeholders will be assessed and the EP then modified if required. If this relates to the identification of a new or significantly increased risk, the revised EP will be submitted to NOPSEMA for assessment.

9.3.3 Equipment (IMR) Monitoring Surveys

For survey activities the following consultation methodology will be adopted:

- Stakeholders will be advised of pending survey activities and also of the survey outcomes after an initial analysis of survey results. An update of the activity will be provided to them;
- Information provided to stakeholders will include (as relevant to the survey scope) the observed survey outcomes (e.g. no observed third party interference, coverage of the Basker-6 flowline, any anomalies observed with an informed assessment of the impact/risk if appropriate);
- Stakeholder feedback based upon this initial analysis will be assessed for objections or claims[21];
- Any objections and claims will be evaluated for merit to inform the engineering/environmental assessment on the following basis:
  - Where the objection or claim has merit, measures adopted to resolve objections and claims will be communicated to the stakeholder;
  - For objections and claims which do not hold merit, Cooper will respond to stakeholders, providing reasoning and supporting information to support Cooper's conclusions. This may include the provision of reasonably available options/controls explored to mitigate the degree to which the stakeholder may be affected and/or demonstration that the risk/impact in question has been reduced to ALARP and acceptable levels.

[21] The definition of objection or claim is the following:

- *To express opposition, protest, concern or complaint about the proposed activities; a request or demand that certain actions be taken by the titleholder to address adverse impacts; and*
- *An assertion that there will be an adverse impact; or allegation to cast doubt about the manner in which the activities will be managed*

Table 9-2: Consultation Summary, Assessment of Merits and Titleholder Response

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Australian Fisheries Management Authority	Management of Commonwealth Commercial Fisheries from 3nm to 200nm (EEZ) New Facilities/expanded footprint which may impact commercial fishery access to seabed areas	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No Response to email dated 2017.02.06	Not Applicable	Not Applicable
Commonwealth Fisheries Association	Peak Group for Commonwealth Fisheries Increased footprint of activities Activity notifications	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No Response to email dated 2017.02.06	Not Applicable	Not Applicable
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.29 between COE, Upstream P.S and CFA representatives in Melbourne.	2017.06.23 No Objections to invitation request 2017.06.29 CFA unable to attend meeting.	No objection to request or advice obtained.	Not Applicable
Lakes Entrance Fishing Cooperative	Fish Processing Cooperative for fish caught in Bass Strait (BMG Area) Change in operation New activities or increased footprint Fishing Damages Process	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No Response to email dated 2017.02.06	Not Applicable	Not Applicable
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.28 between COE, Upstream P.S and LEFCOL representatives at Lakes Entrance.	2017.06.23 No Objections to invitation request	No objection to request or advice obtained.	Action: COE to ensure minutes are undertaken to record to meeting.
Seafood Industry	Peak Industry Body for Victorian seafood and fisheries	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision	No Response to email dated 2017.02.06	Not Applicable	Not Applicable

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Victoria	Increased footprint of activities Activity notifications	and requested feedback.			
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.27 between COE, Upstream P.S and SIV representatives in Melbourne.	2017.06.23 No Objections to invitation request 2017.06.27 SIV unable to attend meeting.	No objection to request or advice obtained.	Not Applicable
San Remo Fishing Cooperative	Fish Processing Cooperative for fish caught in Bass Strait (BMG Area) from Vessels based in San Remo Increased footprint of activities Activity notifications	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No Response to email dated 2017.02.06	Not Applicable	Not Applicable
Sustainable Shark Fishing Inc.	Peak Group for Victorian Seafood - Shark fishing Increased footprint of activities Activity notifications	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No Response to email dated 2017.02.06	Not Applicable	Not Applicable
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.27 between COE, Upstream P.S and SSF representatives at Lakes Entrance.	2017.06.23 No Objections to invitation request	No objection to request or advice obtained.	Action: COE to ensure minutes are undertaken to record to meeting.
Australian Hydrographic Office	Commonwealth Agency responsible for Hydrographic Services such as Notice to Mariners Details of infrastructure placed on Navigation Charts Charting and Information Management	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	2017.02.08 Email response received no comments from AHS, attached updated contact information for the Australian Hydrographic Office	No objection to advice obtained.	Information incorporated into Environment Plan (refer Section 8.11.1) including stakeholder engagement register.

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Marine Border Command	Integrated defence/customs organisation which provides security for offshore marine areas	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	2017.02.06 Email response received no comments automatically generated reply from the Department of Immigration and Border Protection including advice of superseded email addresses.	No objection to advice obtained.	Currency of Stakeholder engagement register verified.
South-East Trawl Fishing Industry Association	Peak Industry Group for Trawl Fishermen in the SE Region Activity Notifications Change in Operation New activities or increased footprint Fishing Damages	COE has been liaising with SETFIA since mid-2012 with respect Stakeholder Engagement mechanisms established by ROC Oil Ltd. ongoing initiatives have developed between COE and SETFIA since.			
		2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	2017.02.07 Email response from S Boag Thanks for the information provided and follow-up on ongoing consultation mechanisms between SETFIA and COE. 2017.02.07 Return Email J Hinks seeking phone conversation to organise quarterly BMG Fishery risk review.	No objection to request or advice obtained.	Not Applicable
			2017.02.08 Email calendar invite for phone conversation between SETFIA (S Boag) and COE (J Hinks) 2017.02.08 Phone conversation between SETFIA (S Boag) and COE (J Hinks) included; • Agenda items for upcoming formal meeting • 2018 Fishing Industry Survey (FIS) – SETFIA to	No objection to request or advice obtained.	Not Applicable

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
			provide map of survey sites, schedule and duration impacts on any scheduled activities.		
			2017.02.22 Email calendar invite for formal meeting to be held on 2017.03.01 between COE, Upstream P.S and SETFIA representatives.	No objection to invitation request.	2017.03.01 Meeting scheduled – Phone conference call attendees COE, SETFIA and Upstream PS representatives.
			2017.04.10 Meeting between Coe, Upstream P.S and SETFIA representatives	No Objections to invitation request	
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.28 between COE, Upstream P.S and SETFIA representatives at Lakes Entrance.	2017.06.23 Email response from S Boag thanks for information provided. 2017.06.23 No Objections to invitation request 2017.06.28 S Boag emailed Meeting notes to COE	No objection to request or advice obtained.	Action: COE to ensure minutes are undertaken to record to meeting.
Australian Maritime Safety Authority	Safety Regulator for Marine Safety and Vessel-based Oil Spill Response in Commonwealth Waters Impacts on Shipping Routes & Navigation Warnings Marine Pollution Controller in Commonwealth Waters for Vessels	2017.02.06 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	2017.02.13 Email received from Senior Advisor Nautical and Hydrographic, AMSA advising as Cooper Energy's activities will occur within the gazetted petroleum exclusion zones, there is nothing further to add from a navigational safety perspective.	No objection to advice obtained, COE note Basker-6 flowline is not covered by a PSZ. BMG PSZ A443819 was gazetted on 15th October 2015	No action required.
		COE has in place MOU's for specific spill response arrangements with AMSA existing offshore assets, an	2017.02.20 Email Automatic reply David Imhoff out of office	Not Applicable	2017.02.27 An AMSA - COE MOU for specific spill response

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
		MOU for the BMG field is still pending. 2017.02.20 Email - Seeking a MoU agreement for the Basker-Manta-Gummy oil and gas field in eastern Gippsland between AMSA and COE.	due to return on 2017.02.23.		arrangements for the BMG field is anticipated to be endorsed in coming weeks 2017.03.14 MOU Endorsed by AMSA and COE
Bairnsdale Air Charter Bob Hussey – Chief pilot	Aviation support	Cooper will undertake pre-qualification of Bairnsdale Air Charter to allow for charter during any oil spill response operational monitoring activities. Bairnsdale Air Charter has 3 x Cessna 337 aircraft to be utilised for this activity.	2017.02.23 Email - Confirmation Bairnsdale Air Charter can support COE, in the event of an oil/condensate spill offshore Gippsland or Otway.	No response received COE to follow-up a response	
Comchart Marine Pty Ltd (Bass Trek & Bass Explorer & Bass Rover)	Vessel Services	Upstream P.S has agreements in place for operating assets, COE is seeking to formalise a Marine Charter Agreement directly with Comchart Marine going forward with respect to Oil Spill Response. 2017.02.22 Email – Arrangements to utilise the Bass Trek based upon a Supplytime 89 arrangement.	2017.02.22 Email - Confirmation Comchart is willing to support COE, by way of a Marine Charter Agreement similar to that in place with Santos	No Issues with comments provided.	COE to progress a Supplytime 89 Agreement with Comchart Marine Pty Ltd
AMOSC	Oil Spill Response Organisation OPEP	COE has been liaising with AMOSC since mid-2012 with respect to Oil Spill Response. COE maintains an Associate Membership with AMOSC			
		2017.02.20 Email – Review of BMG OPEP for the BMG EP Revision, also provided the BMG Oil Spill Trajectory Modelling.	2017.02.24 Email AMOSC provided minor feedback on BMG NPP OPEP. COE updated the OPEP in accordance with this feedback to allow for final review.	Comments received from AMOSC deemed valid and applicable to the BMG field	2017.02.24 All comments incorporated into the OPEP, for finalisation before submission to NOPSEMA
		2017.02.27 Email - Final revision of OPEP sent to AMOSC with comments of 24/2/2017 recognised.	2017.02.27 Email AMOSC response indicating AMOSC	No Issues with	Not Applicable

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
			role responsibilities are accurately reflected within the OPEP	comments provided.	
GHD	Scientific Monitoring Body Principal Consultant - COE by agreement for Cooper Energy - Offshore Victoria Operational & Scientific Monitoring Plan (OSMP) (VIC-ER-EMP-0002) and OSMP Addendum – Implementation Strategy (VIC-ER-EMP-0003)	The overarching operational & scientific monitoring plan (OSMP) has been updated to include BMG activity. • Individual study implementation plans - GHD has provided updated drawings which accommodate BMG activities • GHD provided correct details for the OSMP Addendum – Implementation Strategy			
		2017.02.24 Email - COE confirm with GHD to act as Principal Investigator for OSMP modules and provide necessary staff and resources to implement the modules for the COE Offshore Victoria Operational & Scientific Monitoring Program.	2017.02.24 Email – Confirmation GHD is willing to support Cooper Energy Limited's Offshore Victoria OSMP modules for operations in western Bass Strait and offshore from Gippsland. In the event that the program requires implementation GHD will provide the necessary staff and resources to implement the modules.	No Issues with comments provided.	2017.02.27 COE ensure GHD as PI is incorporated into BMG EP, OPEP & OSMP and subsidiary documents.
Department of Environment, Land Water and Planning (DELWP)	State Agency supporting AMSA with oiled wildlife response.	2016.11.30 – Cooper email requesting current information on oiled wildlife response in Victoria. 2017.02.19 – DELWP provided relevant information which supports oiled wildlife response arrangements to be included within the OPEP.	DELWP provides the following details: • Agency arrangements for oiled wildlife response; • DELWP responses available; • Response arrangements during oil spill; • Notification pathways;	No objections made to the information provided. Included in the OPEP (Oiled Wildlife Response) Section.	Thanked DEDJTR for the current information.

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
			• Relevant actions to be taken.		
VRFish	Peak Industry Body for Victorian seafood and fisheries	2017.02.27 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No response received	Not Applicable	Not Applicable
		2017.06.22 Email – Letter COE provided information associated with 2016 Subsea Inspection. 2017.06.23 Phone call – COE follow-up to discuss letter and arrange a meeting to be held on 2017.06.27 between COE, Upstream P.S and VRFish representatives in Melbourne.	2017.06.23 No Objections to invitation request	No objection to request or advice obtained.	Action: COE to ensure minutes are undertaken to record to meeting.
Esso Australia	Nearby Titleholder	2017.02.06 Posted - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No response received	Not Applicable	Not Applicable
Seven Group Holdings	Nearby Titleholder	2017.02.27 Posted - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No response received	Not Applicable	Not Applicable
Bass Strait Oil Company	Nearby Titleholder	2017.02.27 Email - Letter COE provided information associated with BMG Environment Plan 5 year revision and requested feedback.	No response received	Not Applicable	Not Applicable

10 Titleholder Nominated Liaison Person

Further information associated with the environmental aspects of the BMG Non-Production Phase activities may be obtained from Cooper by writing to:

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