Casino-Henry-Netherby Environment Plan Summary

CONTROLLED DOCUMENT
(CHN-EN-EMP-0003)

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(NOPSEMA)

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Section: Page:

Section: Page:

Other comments:

Revision History

Rev	Issue Date	Revision summary	Originator	Reviewer	Approver
0	07/08/2017	NOPSEMA Submission	L. Chapman	J Hinks	I. MacDougall

Approvals

This Casino-Henry-Netherby Environment Plan Summary has been approved by Cooper Energy for the Operations and Maintenance Phase.

Name	Signature	Date
Iain MacDougall General Manager Operations Cooper Energy Limited		

Glossary

Item	Description
ADIOS	Automated Data Inquiry for oil spills
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHS	Australian Hydrographic Service
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Producers and Exploration Association
API	American Petroleum Institute
AQIS	Australian Quarantine Inspection Service
AVCZ	Central Zone Abalone Industry Association
BIA	Biologically Important Area
BOD	Biological Oxygen Demand
BOM	Bureau of Meteorology
BOP	Blowout Preventer
BTEX	Benzene Toluene Ethylbenzene Xylene
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CH_4	Methane
CHARM	Chemical Hazard and Risk Management Model
CHN	Casino Henry Netherby
CMR	Commonwealth Marine Reserve
CO_2	Carbon Dioxide
CoA	Commonwealth of Australia
CP	Cathodic Protection
CTS	Commonwealth Trawl Sector
DAWR	Department of Agriculture and Water Resources
dB	Decibels
DEDJTR EMD	Department of Economic Development Jobs Transport and Resources Emergency Management Division
DEDJTR ERR	Department of Economic Development Jobs Transport and Resources Earth Resource Regulation (formally Department of Primary Industries (DPI))
DELWP	Department of Environment, Land Water and Planning (Vic) (formally Department of Environment, Planning & Infrastructure (DEPI))
DIIS	Department of Innovation, Industry and Science (Com)
DoD	Department of Defence

Item	Description
DoEE	Department of Energy and Environment (formally Department of Sustainability Environment, Water Population and Communities (SEWPC)) (Com)
DP	Dynamically positioned
DSV	Dive Support Vessel
EC_{50}	Effects Concentration (50% population)
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Lead
EHU	Electro-Hydraulic Umbilical
EMBA	Environment that may be affected
EMT	Emergency Management Team
EP	Environment Plan
EPA	Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation (Act) (Com)
EPO	Environment Performance Outcome
EPS	Environment Performance Standard
EPU	Electrical Power Unit
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
FBE	Fusion Bonded Epoxy
FFG	Flora and Fauna Guarantee (Act)
FSV	Field Support Vessel
GAB	Great Australian Bight
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environment Pollution
GHG	Greenhouse Gas
GHTS	Gillnet Hook and Trap Sector
GoM	Gulf of Mexico
GOR	Gas Oil Ratio
GRT	Gross Register tonnage
GVI	General Visual Inspection
HDD	Horizontal Directional Drill
HDPE	High Density Polyethylene
HP	High Pressure
HSEC	Health Safety Environment & Community
HSEC MS	Health Safety Environment & Community Management System
Hz	Hertz

Item	Description
IAFS	International anti-fouling system
IAPP	International Air Pollution Prevention
ICDA	Internal Corrosion Direct Assessment
IEAPP	International Engine Air Pollution Prevention
IGP	Iona Gas Plant
ILI	Inline Inspection
IMCA	International Marine Contractor Association
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organisation
IMP	Integrity Management Plan
IMR	Inspection maintenance & repair
IMS	Invasive Marine Species
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation
IWCF	International Well Control Forum
JHA	Job Hazard Analysis
KEF	Key Ecological Feature
kHz	Kilohertz
KP	Kilometre Post
LC_{50}	Lethal Concentration (50% population)
LOC	Loss of Containment
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LWD	Logging while drilling
M	Metres
MAH	Mono-aromatic hydrocarbon
MAE	Major Accident Event
MAOP	Maximum Allowable Operating Pressure
MARPOL	International Convention for the Prevention of Pollution from Ships
MBC	Marine Border Control
MDO	Marine diesel oil
MEG	Mono-ethylene Glycol
MLV	Main Line Valve
MMSCFD	Million standard cubic feet per day
MOC	Management of Change

Item	Description
MODU	Mobile Offshore Drilling Unit
MCS	Master Control System
NATPLAN	National Plan for Maritime Environmental Emergencies
NB	Nominal Bore
NDT	Non-destructive Testing
NE	Northeast
NEBA	Net Environmental Benefits Assessment
NES	National Environmental Significance
NFMS	National Marine Fisheries Service
N_2O	Nitrous Oxide
NO_x	Nitrous Oxides
NOEC	No Observable Effects Concentration
NOO	National Oceans Office
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NSW	New South Wales
OCNS	Offshore Chemical Notification Scheme
OIM	Offshore Installation Manager
OIW	Oil in water
OPEP	Oil Pollution Emergency Plan
OPGGSER	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Com)
OPGGSR	Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Vic)
OSMP	Operational & Scientific Management Plan
OSRA	Oil Spill Response Atlas
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
OWS	Oily Water Separator
PAH	Poly-aromatic hydrocarbon
PLEM	Pipeline End Manifold
PLONOR	Poses Little or No Risk
PNEC	Predicted no effects concentration
POB	Persons on Board
Ppb	Parts per billion
Ppm	Parts per million
Ppt	Parts per thousand

Item	Description
PSZ	Petroleum Safety Zone
PTW	Permit to Work
RCC	Rescue Coordination Centre
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
SA	South Australia
SCM	Subsea Control Modules
SDFV	Scuba Divers Association of Victoria
SDS	Safety Data Sheets
SEEMP	Shipboard Energy Efficiency Management Plan
SESSF	Southeast Scalefish and Shark Fishery
SETFIA	Southeast Trawl Fishing Industry Association
SIV	Seafood Industry Victoria
SMPEP	Shipboard Marine Pollution Emergency Plan
SO_X	Sulphur Oxides
SOLAS	International Convention for the Safety of Life at Sea
SOOB	Summary of Operational Boundaries
SOP	Standard Operating Procedure
SSF	Sustainable Shark Fishing Inc.
SSS	Side scan Sonar
SSSV	Subsurface safety valve
SST	Subsea Tree
STCW	Standards of Training Certification and Watch-keeping
STP	Sewage Treatment Plant
SW	Southwest
TAC	Total allowable catch
TACC	Total allowable commercial catch
TEC	Threatened Ecological Community
TPC	Third Party Contractors
TSSC	Threatened Species Scientific Community
TSV	Transport Safety Victoria
UTA	Umbilical Termination Assembly
UXO	Unexploded Ordinances
VADA	Victorian Abalone Divers Association
VEMP	Victoria Emergency Management Plan

Item	Description
VRFish	Victorian Recreational Fishers Association
VRLA	Victorian Rock Lobster Association
WA	Western Australia
WADA	Western Abalone Divers Association
WBM	Water based mud
WHO	World Health Organisation
WNW	West-northwest
WOMP	Well Operations Management Plan

1 Introduction

This Environment Plan (EP) 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 in the Casino Henry Netherby (CHN) Operations and Maintenance Environment Plan accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

1.1 Background

Cooper Energy (CH) Pty Ltd ('Cooper') is the titleholder for Production Licences VIC/L24 (Casino) and VIC/L31 (Henry and Netherby), which contains the CHN gas fields, approximately 30 km southwest from Port Campbell off Victoria's southwest coast in Bass Strait. Cooper Energy (CH) Pty Ltd ('Cooper') is also the titleholder for Pipeline Licences VIC/PL37 and VIC/PL37 (V) (Casino Gas Pipeline) and VIC/PL42 (Casino-Pecten-East Gas Pipeline) which is used to transport gas and condensate from the CHN wells to the Iona Gas Plant (IGP) for gas processing.

The offshore CHN facilities consist of the:

- Casino-4, Casino-5, Henry-2 and Netherby-1 gas production wells (subsea);
- A 32.6-km subsea pipeline (Casino pipeline) connecting the Casino wells to the Iona Gas Plant;
- A 22-km subsea pipeline (Casino to Pecten East pipeline) tying in to the Casino Pipeline, carrying gas from the Henry-2 and Netherby-1 wells, with an additional section to a potential production well in the Pecten reservoir (not part of this EP);
- A 31.2-km electro-hydraulic umbilical (EHU) cable connecting the Casino wells to the onshore Iona Gas Plant (owned and operated by QIC Ltd);
- A 22-km EHU cable (extension of the umbilical above) connecting the Henry and Netherby wells to the Iona Gas Plant.

It is anticipated that this EP will be in place for a period of up to 5 years.

2 Activity Location

The CHN wells are located in water depths ranging from 60m to 70m approximately 30 km southwest of Port Campbell (refer Figure 2-1). The coordinates of the CHN wells and subsea infrastructure is provided in Table 2-1.

The CHN gas pipeline system includes (refer Figure 2-2):

- Casino-4 and Casino-5 in 70 m water depth.
- Henry-2 and Netherby-1 in 67 m and 63 m water depth respectively, with spools to connect the subsea trees to the Casino pipeline.
- A 32.6-km long, 300 mm nominal diameter pipeline, connecting the Casino wells to the IGP (Stage I pipeline);
- A 22-km long, 300 mm nominal diameter Casino to Pecten East pipeline (Stage II pipeline), tying in to the offshore end of the Casino Pipeline, carrying gas from the Henry-2 and Netherby-1 wells;
- The 120 mm diameter EHU cable, 31.2-km long, connecting the Casino wells to the Iona Gas Plant;
- The 135 mm diameter EHU cable (extension of the umbilical described above), 22-km long, connecting the Henry and Netherby wells to the Iona Gas Plant.

Provision for Future Operations: The Stage II Pipeline makes provision for connection to a future gas production well that may be drilled in the Pecten East prospect.

Figure 2-1: Casino-Henry-Netherby Gas Fields and Pipeline Location

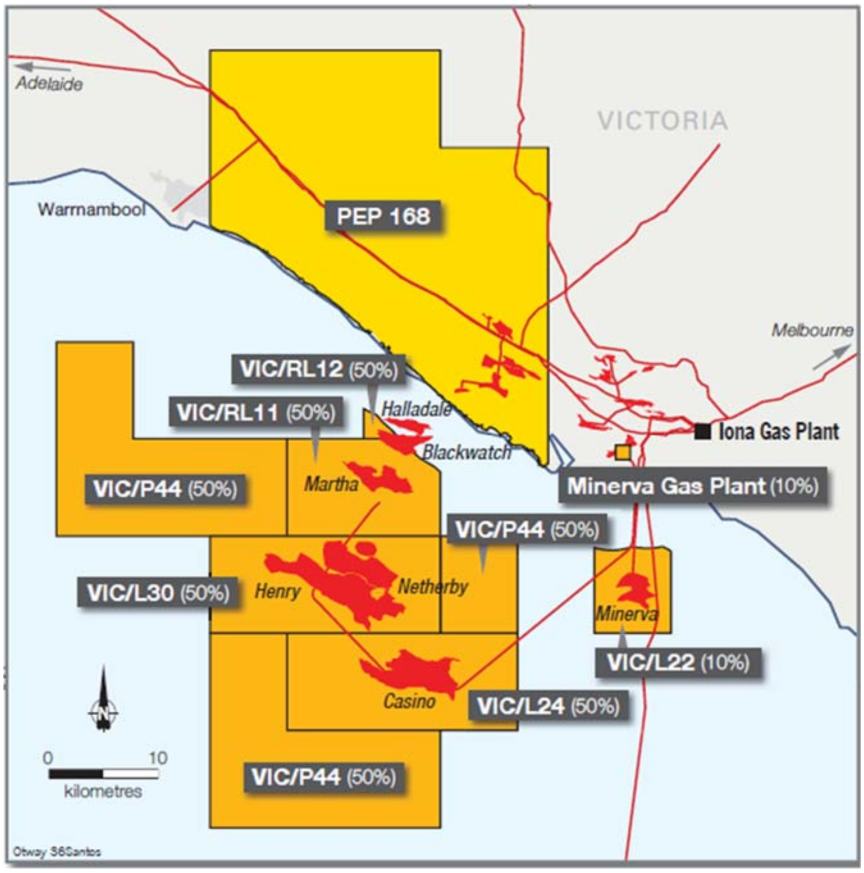
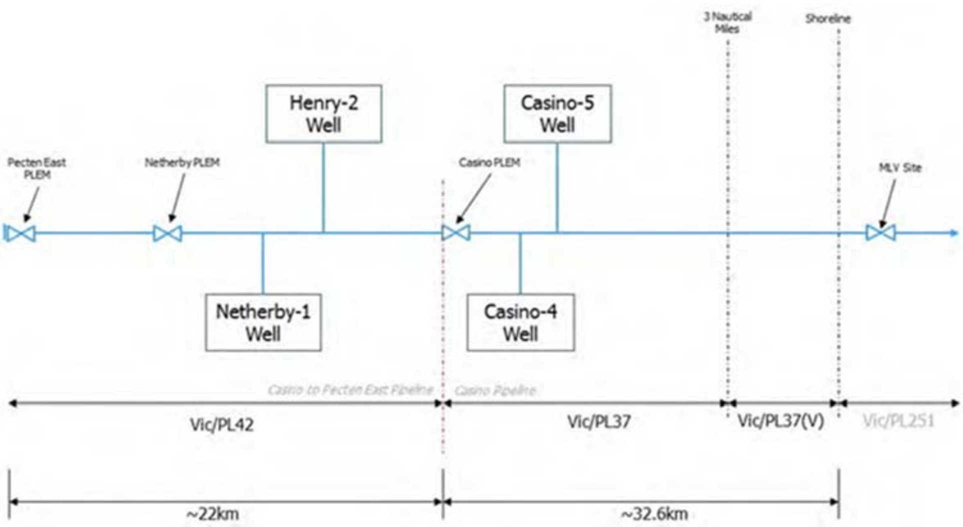


Table 2-1: Coordinates of CHN Infrastructure

Infrastructure	Location (GDA 1994, GRS80, UTM Zone 55) (Degrees Minutes, Seconds)	
	Latitude	Longitude
CHN wells		
Casino-4	38° 47' 13.03"	142° 41' 54.48"
Casino-5	38° 47' 43.68"	142° 44' 44.59"
Henry-2	38° 42' 14.55"	142° 37' 13.05"
Netherby-1	38° 40' 48.58"	142° 38' 25.74"
Casino Pipeline Coordinates		
HDD Entry	38° 36' 55.88"	142° 57' 49.43"
HDD Exit	38° 37' 46.54"	142° 57' 46.02"
Tangent Point 1	38° 39' 59.26"	142° 57' 37.11"
Tangent Point 2	38° 40' 45.83"	142° 57' 7.22"
Tangent Point 3	38° 47' 37.48"	142° 46' 29.83"
Tangent Point 4	38° 47' 50.63"	142° 45' 18.61"
Pipeline End	38° 47' 13.81"	142° 41' 54.08"
Casino-Pecten East Pipeline		
Pecten East Lay down flange	38° 38' 10.83"	142° 41' 8.71"
Tangent Point 1	38° 41' 29.18"	142° 37' 43.01"
Tangent Point 2	38° 41' 36.04 "	142° 37' 37.33"
Tangent Point 3	38° 42' 35.28"	142° 36' 58.86"
Tangent Point 4	38° 43' 19.76"	142° 37' 7.14"
Casino tie-in initiation flange	38° 47' 4.77"	142° 41' 52.36"

Figure 2-2: Pipeline Licence Boundaries



3 Activity Description

3.1 Overview

Gas production from the Casino field commenced in 2005 and gas production from Henry-2 and Netherby-1 in 2010. The petroleum activity consists of the operation and maintenance of four subsea production wells, as outlined below:

- Casino-4 and Casino-5 complete with wellheads and trees at the seabed in 70 m water depth.
- Henry-2 and Netherby-1 complete with subsea wellheads and trees at the seabed in 67 m and 63 m water depth respectively, with spools to connect the subsea trees to the Casino pipeline.
- A 32.6-km long, 300 mm nominal diameter pipeline, connecting the Casino wells to the Iona Gas Plant (Stage I pipeline). The Stage I pipeline is not trenched into, but laid directly onto the seabed. It is stabilised with 271 concrete articulated mattresses to prevent movements induced by ocean currents at the seabed (the adjacent umbilical is stabilised by 84 mattresses)
- A 22-km long, 300 mm nominal diameter Casino to Pecten East pipeline (Stage II pipeline), tying in to the offshore end of the Casino Pipeline, carrying gas from the Henry-2 and Netherby-1 wells. The Stage II pipeline was also not trenched into, but was laid directly onto the seabed. It is stabilised with 390 concrete mattresses to prevent movements induced by ocean currents at the seabed (the adjacent umbilical is stabilised by 240 concrete mattresses).
- The 120 mm diameter EHU cable, 31.2-km long, connecting the Casino wells to the Iona Gas Plant. The umbilical contains three lines, carrying chemicals, electrical power and hydraulic fluids.
- The 135 mm diameter EHU cable (extension of the umbilical described above), 22-km long, connecting the Henry and Netherby wells to the Iona Gas Plant.

Five and a half kilometres (5.5 km) of the Casino pipeline and associated EHU cable are located in Victorian state waters.

Provision for Future Operations:

The Stage II Pipeline makes provision for connection to a future gas production well that may be drilled in the Pecten East prospect. The pipeline extends northeast past the Netherby-1 well (refer Figure 2-2) so that a future Pecten East production well requires only a short connection to the existing pipeline. The timing of drilling this well and connection to existing infrastructure for gas production will be determined by the rate of gas production decline from existing production wells however, it is not guaranteed that this well will be drilled.

Should drilling and construction activities occur associated with Pecten East, it will be covered by a separate EP submission to NOPSEMA for approval prior to commencement

It should be noted that the Stage II pipeline section between Netherby and Pecten East is isolated at Netherby by a double block and bleed valve set-up, and filled with inhibited water. This pipeline section was filled within inhibited water in 2009.

3.2 Field Characteristics and Production

The condensate of the CHN reservoirs is classified as a Group 1 (non-persistent) oil. Compositional details of the three reservoirs are provided in Table 3-1. Netherby condensate is considered to be representative of the three reservoirs. Physical characteristics of Netherby condensate is provided in Table 3-2.

Table 3-1: Casino-Henry-Netherby Gas Composition

Component	Casino		Henry/Netherby
	Casino-4 (Waarre-A)	Casino-5 (Waarre-C)	Henry-2 (Waarre-A) Netherby-1 (Waarre-A)
Hydrogen sulphide	0.00	0.00	0.00
Nitrogen	3.19	2.12	1.59
Carbon Dioxide	0.57	0.88	0.07
Methane	93.60	94.15	94.82
Ethane	1.51	1.93	2.26
Propane	0.45	0.45	0.60
i-Butane	0.14	0.09	0.12
n-Butane	0.13	0.10	0.18
i-Pentane	0.05	0.03	0.04
n-Pentane	0.04	0.02	0.04
Hexane	0.05	0.04	0.07
Heptane	0.09	0.07	0.10
Octane	0.04	0.06	0.04
Nonane	0.04	0.03	0.02
Decane	0.02	0.01	0.02
Undecane	0.03	0.01	0.01
Dodecane+	0.01	0.02	0.02
TOTAL	**100**	**100**	**100**

Table 3-2: Physical Characteristics of Netherby Condensate

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low volatiles (%)	Residuals (%)	Density (kg/m^3)	Dynamic viscosity (%)
Boiling point (°C)	<180	180-265	265-380	>380		
Aromatics	MAHs	2-ring PAHs	3-ring PAHs	≥4 rings		
Aliphatics	$C_4 – C_{10}$	$C_{10} – C_{15}$	$C_{15} – C_{20}$	$>C_{20}$		
Nertherby condensate	84	14	2	0	774 @ 16 °C	0.14 @ 25 °C
	Non-persistent			Persistent		

3.3 Subsea Operations

While the activities occurring within the Iona Gas Plant are excluded from the scope of this EP, brief details are provided for contextual purposes.

The Iona Gas Plant is operated by Lochard Energy and is located at 305 Waarre Road, Port Campbell. The gas plant is located above a depleted gas field, with its primary function being to supply gas from the underground storage facility and process gas from the offshore CHN assets. This plant is continuously manned.

The gas plant receives raw gas from the CHN fields via a 12-km long onshore pipeline (PL251). In addition it also has the capability to receive gas from onshore wells (e.g., Wallaby Creek, North Paaratte and Iona). The plant provides gas conditioning (dehydration and dew point), injection and compression services for delivery into the Victorian and South Australian gas markets via the SEA Gas Pipeline and South West Pipeline.

The operation, monitoring and control of the CHN wells are conducted remotely from the Iona Gas Plant through control via the EHU. All well functions are monitored and controlled from the gas plant control room through a Master Control System (MCS) via a Subsea Control Module (SCM) located at each wellhead. All subsea control systems are electro-hydraulic. The Hydraulic Power Unit (HPU) and the Electrical Power Unit (EPU) at the Iona Gas Plant provide the hydraulic and electric power to the subsea controls. The EHU cable is linked to each wellhead via a subsea Umbilical Termination Assembly (UTAs) located at each tree take-off point. The connection between the UTAs and the trees is by electro-hydraulic flying leads.

Isolation of the pipeline occurs at the offshore wells, the onshore Main-Line Valve (MLV) site and at the inlet to the Iona Gas Plant upstream of the Casino Slug Catcher. Isolation valves are function tested annually, and leak tested as part of any planned shutdown. There are also sub-surface safety and wellhead isolation valves that are function tested and leak tested every 12 months. Details regarding the functioning of the EHU are described below.

3.3.1 Hydrate Control

Mono-ethylene glycol (MEG) (90% MEG, 10% water) is continuously injected into the wellheads to prevent the formation of hydrates that could lead to pipeline blockages. The delivery of MEG to the pipelines is via three dedicated cores within the EHU (19 mm nominal bore (NB) diameter). The MEG delivery, recovery and regeneration systems are located at the Iona Gas Plant. MEG is not discharged to the ocean. MEG has an ‘E’ (non-CHARM) Offshore Chemical Notification Scheme (OCNS) rating.

Methanol can be injected to dissipate any hydrates that form. The delivery of methanol to the pipelines is via one dedicated core within the EHU (19 mm nominal bore (NB) diameter). Methanol has an ‘E’ (non-CHARM) OCNS rating.

3.3.2 Corrosion Control

Corrosion control within the CHN assets is currently achieved through pH adjustment of the MEG system by injection of sodium hydroxide (NaOH) at the Iona Gas Plant. As above MEG has an ‘E’ non-CHARM OCNS rating.

3.3.3 Valve Control

There are two high-pressure (HP) and two low-pressure (LP) hydraulic lines within the EHU (12.7 mm NB diameter). These lines currently carry Castrol Transaqua HT2 hydraulic fluid which consists of 30-60% ethylene glycol. This product is commonly used throughout offshore production facilities in Bass Strait. Approximately 3 litres of hydraulic fluid is discharged when each wellhead isolation valve closes. Castrol Transaqua HT2 has a 'D' (non-CHARM) OCNS rating (CEFAS, 2017a).

3.3.4 Scale Inhibitor

To prevent scaling within wellhead choke systems, the scale inhibitor Gyptron SA-3220, whose active ingredient is a maleic copolymer, is currently injected at a concentration of 200-250 ppm into the MEG system. Gyptron SA-3220 has a 'D' (non-CHARM) OCNS rating with no substitution warning (CEFAS, 2017a).

3.4 Infrastructure Integrity Management

The CHN Integrity Management Plan (IMP) covers the management, monitoring and inspection activities for the CHN assets. Items monitored as part of the CHN IMP include:

- *Water samples and analyses:* Sampling of pipeline water at Iona Gas Plant to enable trending of quantities such as: iron count, chlorides content, bacteria count, inhibitor residuals etc.
- *Hydraulic Fluid Pressure/Consumption monitoring:* A regular check to monitor pressure levels of hydraulic fluid within umbilical's and jumpers and consumption of fluid volumes.
- *Internal Corrosion Direct Assessment (ICDA):* Where pigging facilities are not installed, an analytical technique used to predict locations of internal corrosion. This process may also be used to specify localized inspection for evidence of deterioration.
- *In-line Inspections (ILI):* The use of a flow driven 'intelligent' pig vehicle to measure the wall thickness of a steel pipeline along its complete route, by magnetic (gas & liquid pipelines) or ultrasonic (liquid pipelines) techniques.
- *Pipeline ROV surveys:* The use of a ROV to visually inspect the condition of the pipeline along its entire route – this includes the measurement of the Cathodic Protection (CP) system and free spanning greater than design.
- *Structure/subsea Tree ROV Survey:* The use of a ROV to visually inspect the condition of the facility including the measurement of the CP potentials.

3.4.1 Internal Corrosion Mitigation Measures

Carbon dioxide, hydrogen sulphide and other organic acids have the potential to dissolve into liquid water creating acids that lead to internal corrosion. The Pipeline design includes an internal corrosion allowance of 3 mm as per the requirements specified in DNV-OS-F101.

Internal corrosion is managed by continuous injection of pH adjusted MEG from the Iona Gas Plant. The MEG is pumped offshore via the umbilical to the wells and into the well stream upstream of the wing valve. MEG is distributed along the pipeline by the produced gas and liquid flow to control pH to minimise acid gas corrosion.

Monitoring of the effectiveness of this risk control measure is achieved as follows:

- MEG injection system located at the Iona Gas Plant, is monitored for continued MEG flowrate by Gas Plant Operators; and
- Regular sampling and analysis is carried out to ensure that the MEG/water mixture remains pH stabilised, to monitor reservoir fluid chemistry and monitor the effectiveness of the pH stabilisation.

Depending on these results an internal inspection of the pipeline by intelligent pig may be undertaken if internal corrosion is estimated to be sufficiently high. However, given the control measures described, the low level corrosivity of the well-fluids and the corrosion allowance provided in the original pipeline wall thickness, the likelihood of such an inspection being warranted is minimal.

3.4.2 External Integrity Mitigation Measures

External corrosion mitigation for the offshore pipeline is provided by:

- Anti-corrosion Coating:
    - External corrosion protection of the offshore pipeline is provided by a factory applied 3LPP (FBE / adhesive / polypropylene) of 2.5 mm thickness, and heat shrink sleeves applied at the field joint locations;
    - The HDD section features a 1.125mm thick dual-layer Fusion Bonded Epoxy (FBE) coating system, consisting of an FBE corrosion coating applied directly to the steel pipe surface, and a 'Nap Rock' thermosetting top coat applied directly to the FBE between KP0.0 and KP2.0 for abrasion resistance;
    - Subsea structures (trees etc.) are coated with 2 pack epoxy.
- Cathodic Protection:
    - The offshore pipelines are protected by aluminium / zinc bracelet type sacrificial anodes installed along the full length of pipeline to provide protection in case of damage to the anti-corrosion coating;
    - The HDD section is protected by zinc ribbon anodes fixed directly to the pipeline for the HDD section from the surface to approximately 900m downhole (High Density Polyethylene (HDPE) liner section), and impressed current from the end of the HDPE liner section
    - Structures use their own anodes and are bonded to the pipeline CP system.

The protective coating and anodes were inspected and confirmed satisfactory during the initial installation of these pipelines. Subsequent inspection of the condition of both the protective coating and the anodes is by ROV inspection.

The frequency of inspections is decided by the Cooper Energy Technical Integrity Engineer (dependent on the previous inspection results) in line with the requirements detailed in the IMP. Frequencies of inspections may range from 1 to 5 years. The next planned GVI is 2019.

There are no plans to repair the installed pipeline protective coating on the subsea pipeline if it should show evidence of impact damage. The corrosion mitigation step for such damage would be to replace the sacrificial anodes more frequently.

External corrosion in the HDD section is monitored as part of the routine inspection of the HDD shore crossing. This includes checking CP potentials at the onshore end every 6 months during the onshore CP survey and at the offshore end during scheduled offshore ROV surveys. Coating defect surveys are not possible due to the depth of cover and the nature of the ground (rock). The only technique capable of providing adequate data to assure the pipeline integrity within the HDD shore crossing is an In-Line Inspection (ILI) that measures the wall thickness of the pipe. The HDD was subject to an ILI in early 2016 with no metal loss features found.

3.5 Maintenance and Repair Activities

The following inspection, maintenance and repair (IMR) activities are undertaken or may be undertaken on the CHN assets:

- Inline inspections (ILI) of the offshore pipelines (onshore launch/receipt only for HDD section);

- Inspection and repair work using Remote Operated Vehicle (ROV), Side Scan Sonars (SSS), Field Support Vessels (FSV) and/or diving from a Dive Support Vessel (DSV), such as:
  - Periodic general visual inspection (GVI) surveys to assess the condition of the pipeline, umbilical and wellheads undertaken by ROV;
  - Non-destructive testing (NDT) of the offshore pipeline typically undertaken by ROV;
  - Pipeline span/structure (e.g. PLEM, UTAs) scour rectification;
  - Marine growth removal;
  - Rectification of an electrical or hydraulic fault associated with the EHU and associated connected equipment;
  - Choke replacement and repairs (as required);
  - Replacement and repairs of depleted or damaged cathodic protection anodes on an as-needs basis;
  - Flowline jumper replacement;
- Pipeline repair which may, depending upon the damage the pipeline has sustained, include:
  - *Composite wrap application:* This consists of removing seabed sediments below and around the affected area (typically 0.5m below pipeline and for a maximum length consistent with the free span anomaly criteria); water-jet or wire-brush the pipeline surface; apply filler/primer (typically an epoxy-resin); apply composite wrap and span rectification works (e.g. grout bags).
  - *Bolted clamps (both grouted and ungrouted):* This consists of removing seabed sedimentation around the pipework and support pipe (as above), apply clamp; apply grout through the grout port (as necessary) and rectify span (e.g. grout bags).
  - *Pipeline cut-out and replacement by welded connection*: This consists of removing seabed sedimentation around the pipeline (as above); removal of the damaged portion of pipeline by a diamond saw or rotary milling cutter by divers or ROV; alignment adjusted and ends prepared and a new spool piece welded to the pipeline.
  - *Pipe cut-out and replacement by mechanical connector:* This involves the technique described above for welded connection however a spool piece with mechanical connectors at either end is installed with the connectors gripping the pipework.

    Cut out and replacement repair techniques would only be considered for loss of containment events where pipeline contents have been vented. Any remaining pipeline contents would be displaced most likely with seawater.

  All chemicals utilised in pipeline repair will meet the requirements of Cooper Energy's Chemical Selection Standards.

Note that DSV operations operate under a vessel-specific Safety Case.

All maintenance activities are expected to be of short duration, lasting from 2-7 days dependent on activity type and weather conditions. The following maintenance activities have taken place since the CHN assets commenced operations:

- A subsea survey of the pipeline was performed in March 2007, which surveyed the pipeline, subsea trees, umbilical and control equipment. A full survey of the CP system was performed at the time. There were no major anomalies and the free spans were all acceptable according to the DNV recommended practice. The concrete stabilisation mattresses were in place and no movement of the pipeline was detected. There were no major issues related to the CP system.

- An ROV and CP inspection of the wellheads, umbilical and pipelines was undertaken in January 2011. Reported anomalies comprised missing continuity straps, loose field joint coating sleeves and several anomalous free spans (19 of which were repaired with grout-bag supports at the end of the survey).
- Replacement of the Henry wellhead choke and general inspection activities were conducted between 28th May and 3rd June 2013.
- In 2015 a CP and ROV inspection was conducted on all offshore facilities;
- Monitoring of the metocean conditions to date revealed that the design (100 year return period) has not been exceeded to date.

3.5.1 Inline Inspections (Pigging)

The CHN pipeline undergoes in-line inspections by launching and retrieving a bi-directional pig from the MLV station onshore primarily to establish the integrity of the HDD section of VIC/PL37(v). This activity was successfully undertaken in 2016. There are no emissions or discharges to the marine environment utilising this method.

The combined Casino Stage I pipeline (Vic/PL37) and Casino Stage II pipeline (Vic/PL42) is designed to be piggable from offshore to onshore when offshore launching equipment is installed. Isolation facilities are provided at the end of Vic/PL42 to enable the installation offshore of a subsea pig-launching skid without depressurisation of the pipeline however there is currently no intention that pigging the Pecten East to shore pipeline will be undertaken by this method.

3.5.2 Inspections

Maintenance and inspection activities will be undertaken by ROV or diving contractors. Marine vessels considered for ROV or diving work are usually of commercial trawler size and typical of the size of vessel found in Portland or Warrnambool. However, there may be instances where non-local vessels are considered for ROV work.

ROV inspection activities normally comprise a simple visual and CP survey that may involve contact with the subsea infrastructure, usually after events such as major storms. Such inspections check for disturbance or damage to the subsea infrastructure that may impact on safe operations.

3.5.3 Marine Growth Removal

As part of ongoing maintenance and to facilitate inspections, the removal of marine growth from infrastructure using inspection or work-class ROV and/or divers may be required. This would be of short duration at any one location. Marine growth will be removed with high pressure water blasting, brushing or grit-blasting, or a combination of these as described below. Marine growth removal has occurred on the CHN facilities.

- Water-jetting – typically conducted by ROV, water will be pressurised 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.
- Brushing – typically a coarse brush would be applied to the pipeline or structure on a localised area only, though this is less common.

- Grit blasting – may be required to expose parent metal on very localised areas only (typically spot checks and localised NDT). This less common activity is conducted via diver intervention. A down line is used with compressed air and beach sand fed into a hopper that is then fed down a hose to the subsea location. Air and beach sand would be the only components of this type of cleaning technique. It is expected to be seldom required.

3.5.4 Span Rectification

Future pipeline span rectifications may be required to prevent possible damage to the pipeline.

Spans can be filled in through the use of a grout bag (a bladder/bag) that is positioned under the pipeline and pumped full of grout until the bag supports the pipeline. This method can address scouring issues around support structures and are checked to confirm that these are stable under storm conditions. A FSV is used to support this activity.

Grout bags have been installed on recent campaigns to rectify pipeline spanning issues.

Cement and associated chemicals are reviewed and selected based on their technical suitability and their environmental toxicity (i.e., preference will be given to chemicals with low environmental impact chemicals).

3.5.5 Rectification of Electrical Faults

Various electrical faults have occurred in the offshore power systems. Faults may occur in the umbilical itself, umbilical termination assemblies, electrical flying leads (EFLs) or SCM’s.

Depending on the type of fault, several options may be available to rectify the fault. This may include replacement of the part in situ or retrieval to surface. This work may be done by ROV or by divers.

3.5.6 Choke Repair/Replacement

Wellhead choke replacement can be conducted by ROV or by divers. Replacement of a choke will require displacement of gas in the flowline jumper with MEG and the venting of small amounts of gas only to de-pressure the system for repair.

3.5.7 Repair/Replacement of Cathodic Protection Anodes

Cathodic Protection (CP) anodes exist as bracelets, pipeline anodes or bar anodes. Anodes are installed by bolting them to the structure/pipe and installing continuity straps. Continuity straps are either pre-welded during the initial installation or are bolted onto the metal structure subsea. CP anode repair can be conducted by ROV or by divers.

3.6 Support Activities

3.6.1 Vessels

IMR activities are undertaken with the aid of a survey vessel. Vessels are contracted from international or national suppliers when required and will vary depending on the proposed activity and vessel availability.

Typical vessels utilised in IMR activities are expected to be local service vessels. These vessels typically have a gross tonnage of 300 tonnes and a fuel capacity of 48 m^3, with fuel spread between numerous tanks (maximum size of 12 m^3). Larger vessels, perhaps internationally-sourced, may be used in activities that involve IMR activities or source control activities such as capping on wellheads. The largest fuel tank on these vessels is in the order of 160 m^3.

Depending on the IMR activities required vessels are likely to be at sea between seven and nine days. Given their greater fuel capacity, larger vessels can remain at sea for longer periods, however smaller vessels may require a port visit to refuel. No vessel refuelling will be undertaken at sea.

Any vessels used will have the necessary certification/registration and be fully compliant with the relevant MARPOL and SOLAS convention requirements specific for the vessel's size and purpose.

3.6.2 Aviation

Depending upon the size of the vessel, helicopters may be used in the field in support of offshore campaign operations, including:

- Personnel transfers between heliports and field vessels;
- Occasional transportation of equipment to/from the field vessel; and
- Heavy weather emergency evacuation, search and rescue, and Medivac operations.

3.7 Spill Response Activities

This EP also provides for the response activities to hydrocarbon spills from CHN assets or petroleum activities associated with those assets. A full assessment of the response options associated with spill events is provided in Section 7.22 and includes responses for:

- Source Control;
- Monitoring and evaluation of the spill;
- Protection and deflection at sensitive shorelines;
- Shoreline assessment and clean-up; and
- Oiled wildlife response (OWR).

In the event of a spill, source control measures will be undertaken to stop the flow of hydrocarbons and tactical response strategies applied to mitigate spill impacts according to the nature and scale of the release. For significant wellhead related incidents this may include the following activities:

- For Level 2 spill incidents ROV intervention utilising specialise ROV tooling (marine-based activity); and
- For Level 3 incidents well capping (vessel-based activity) or well kill via a relief well (Mobile Offshore Drilling Unit (MODU) activity).

3.7.1 Well Capping

Well capping serves to curtail the hydrocarbon flow prior to permanent plugging of the well. Activities expected to be undertaken to support well capping include site surveys, to understand the issues and constraints of installation; possible debris removal involving the use of ROVs, the cutting and removal of subsea equipment to ensure a clear surface for capping; and capping stack deployment and installation by an DSV.

3.7.2 Relief Well

Parallel with the assessment of well capping options will be assessment of a relief well to contain the well. A relief well is typically drilled as a straight hole down to a planned kick-off point, where it is turned towards the target using directional drilling technology and tools to get within 30-60 m of the original well. Directional drilling continues with routine magnetic ranging checks to allow for the original well to be intersected. Once the target well is intersected dynamic kill commences by pumping mud and or cement downhole to seal the original well bore.

4 Receiving Environment

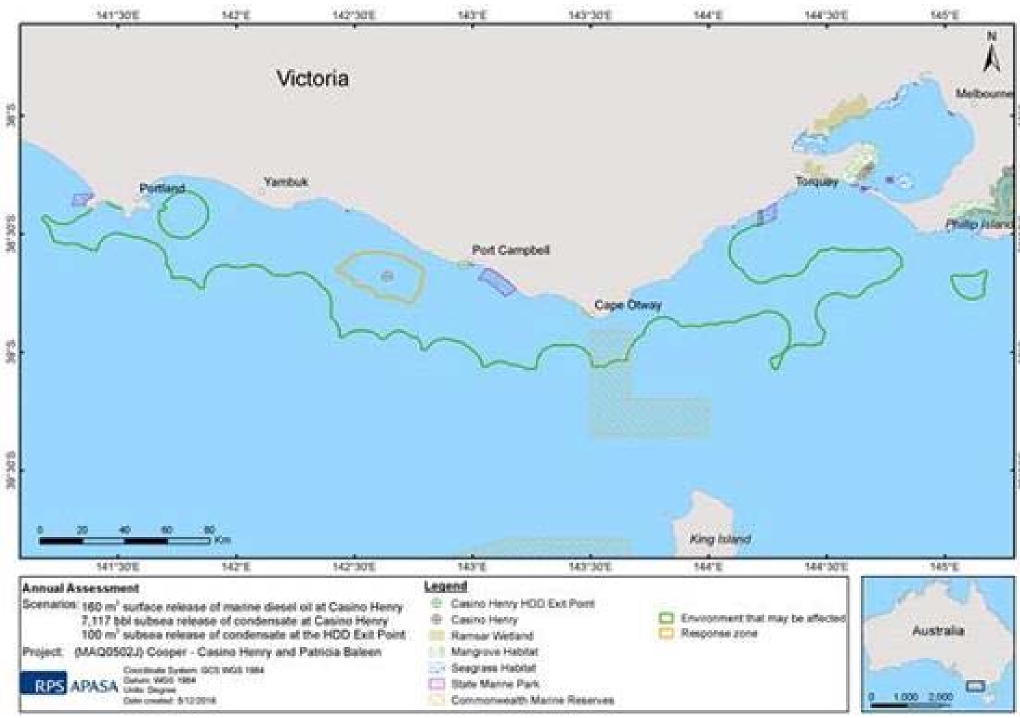
The CHN assets are located within the south-east marine bioregion and Otway marine bioregion as classified by the Interim Marine and Coastal Regionalisation for Australia (IMCRA). This bioregion extends from Cape Otway (Vic) to Cape Jaffa (South Australia) and includes the western islands of Bass Strait such as King Island.

The Otway coastline and marine environment include very steep to moderate offshore gradients, high wave energy and cold temperate waters subject to upwelling events (i.e., the Bonney Upwelling). Upwelling water is nutrient rich and corresponds with increases in the abundance of zooplankton, which attracts baleen whales and other species (including EPBC-listed species) that feed on the plankton swarms (krill). Shoreline habitats of the Otway coastline include penguin colonies, fur seal colonies and bird nesting sites.

The receiving environment has been defined as the "environment that may be affected (EMBA)" based upon the maximum credible oil spill footprint which might occur during asset operations. The EMBA is therefore defined as the area that could potentially be impacted in the event a vessel diesel spill (refer Figure 4-1). The EMBA is thus defined as:

The probable extent of low level hydrocarbon exposure to the sea surface (>0.5 µm surface oil), entrained in the water column (>672 ppb.hrs total petroleum hydrocarbons) and shoreline contact (>100 g/m^2) as a result of the loss of 160 m^3 of marine diesel oil from a vessel[1]. This effectively includes the shoreline from Cape Nelson in the west to Anglesea in the east.

Figure 4-1: CHN Petroleum Activity EMBA



[1] This is the largest impact oil spill identified for the petroleum activity.

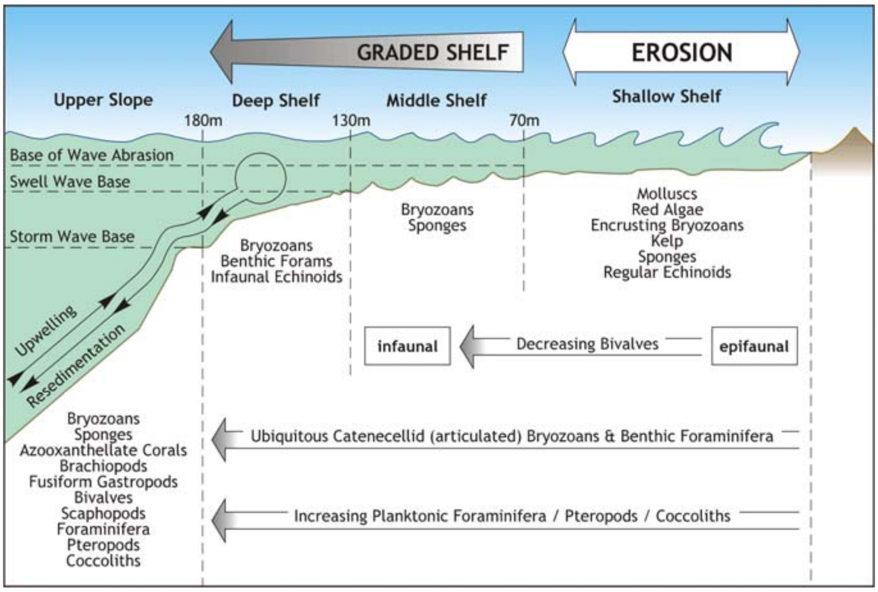
4.1 Physical Environment

4.1.1 Bathymetry, Seabed and Shallow Geology

The CHN assets are located within the 400 km-long Otway Shelf, which lies between 37° and 43.5°S and 139.5°E (Cape Jaffa) and 143.5°E (Cape Otway). The narrowest point is off Portland, where the shelf is less than 20 km wide. It broadens progressively westward, to 60 km off Robe, SA, and eastward to 80 km off Warrnambool (James *et al*., 2013). The Otway shelf is comprised of Miocene limestone below a thin veneer of younger sediments.

Based on assessment of the sampled sediments the authors concluded the Otway continental margin is a swell-dominated, open, cool-water, carbonate platform. A conceptual model was developed that divided the Otway continental margin into five depth-related zones – shallow shelf, middle shelf, deep-shelf, shelf edge and upper slope (refer Figure 4-2).

Figure 4-2: Model of geomorphology of the Otway shelf



The Casino gas pipeline route in water depths <60 m consisted of large tracts of fine to coarse grained sand with little or no epifauna and that infaunal communities of bivalves, polychaetes and crustaceans probably dominate in the open sand habitat. From the HDD exit point (18 m water depth) to approximately 60 m water depth, the seabed is classified as sand or fine gravel. Beyond 60 m water depth, out to the Casino well sites, the seabed is characterized by outcrops of hard substrate with very low relief and structural complexity separated by gullies of sand or fine gravel (Santos, 2004). The seabed surrounding the Casino wellheads consists of thin, interspersed sediments between outcropping rock.

The seabed along the Casino to Pecten East pipeline area typically consists of low relief rock outcrop with no significant sediment cover in water depths varying from 65 to 70 m. No significant items of debris or major sediment obstruction were identified during acoustic surveys (Coffey, 2008).

4.1.2 Climate

The region's climate is cool temperate region with cold, wet winters and warm dry summers. It is dominated by sub-tropical high pressure systems in summer and sub-polar low pressure systems in winter. The low pressure systems are accompanied by strong westerly winds and rain-bearing cold fronts that move from south-west to north-east across the region, producing strong winds from the west, north-west and south-west.

4.1.3 Winds

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

Occasionally, intense mesoscale low-pressure systems occur in the region, bringing very strong winds, heavy rain, and high seas. These events are unpredictable in occurrence, intensity, and behaviour, but are most common between September and February (McInnes & Hubbert, 2003). Wind speeds in the area are typically in the range of 10–30 km/hr, with maximum gusts reaching 100 km/hr.

4.1.4 Currents

Winds tend to be the primary factor driving currents in western Bass Strait, predominantly from west to east. Bottom currents can exceed 0.5 m/s in nearshore areas during storms (Santos, 2004). Current velocities through Bass Strait are highly correlated with local wind stress (Santos, 2004). In the Port Campbell area, the predominant south-westerly swell direction means that there are minimal longshore currents as most waves reach the shore parallel to the coast. Therefore, in waters less than 10 m deep, water movements are influenced mainly by orbital motion waves and localised wave-generated currents (Santos 2004).

Lateral flushing within Bass Strait results from inflows from the South Australian Current, East Australian Current and sub-Antarctic surface waters (APASA, 2013). During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Strait. In winter and spring, waters within the strait are well mixed with no obvious stratification, while during summer the central regions of the straight become stratified (APASA, 2013).

4.1.5 Tides

Tides are semi-diurnal with some diurnal inequalities (Jones & Padman, 2006; Easton, 1970), generating tidal currents along a north-west/south-east axis, with speeds generally ranging from 0.1 to 2.5 m/s (Fandry, 1983). The maximum range of spring tides in western Bass Strait is approximately 1.2 m. Sea level variation in the area can arise from storm surges and wave set up (Santos, 2004).

4.1.6 Sea Temperature

Sea-surface water temperatures vary seasonally from a minimum of 12.6ºC to a maximum of 18.4ºC (APASA, 2013). The southwest region of Victorian area has significant upwelling of colder, nutrient rich deep water during summer that can cause sea surface temperatures to decrease by 3°C compared with offshore waters (Butler *et al*., 2002).

4.1.7 Waves

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights. The Otway coastline has a predominantly south-westerly aspect and is highly exposed to southern ocean swells. The two principal sources of wave energy in the Otway Basin are from:

- The westerly swell from the Great Australian Bight and Southern Ocean; and
- Locally-generated winds, generally from the west and east.

The Otway area is fully exposed to long period 13 second average south-westerly swell from the Southern Ocean as well as periodic shorter 8 second average period waves from the east. Wave heights from these winds generally range from 1.5 m to 2 m, although waves heights to 10 m can occur during storm events.

In-situ wave measurements in the northern portion of the Casino pipeline, revealed that 2 to 3.5 m waves occur for 50% of the time and waves over 7.6 m in height occur during winter (Santos, 2004). Close to shore, waves are estimated to break at the 7 m depth contour about 50% of the time (Santos, 2004).

4.2 Biological Environment

4.2.1 Benthic Environment

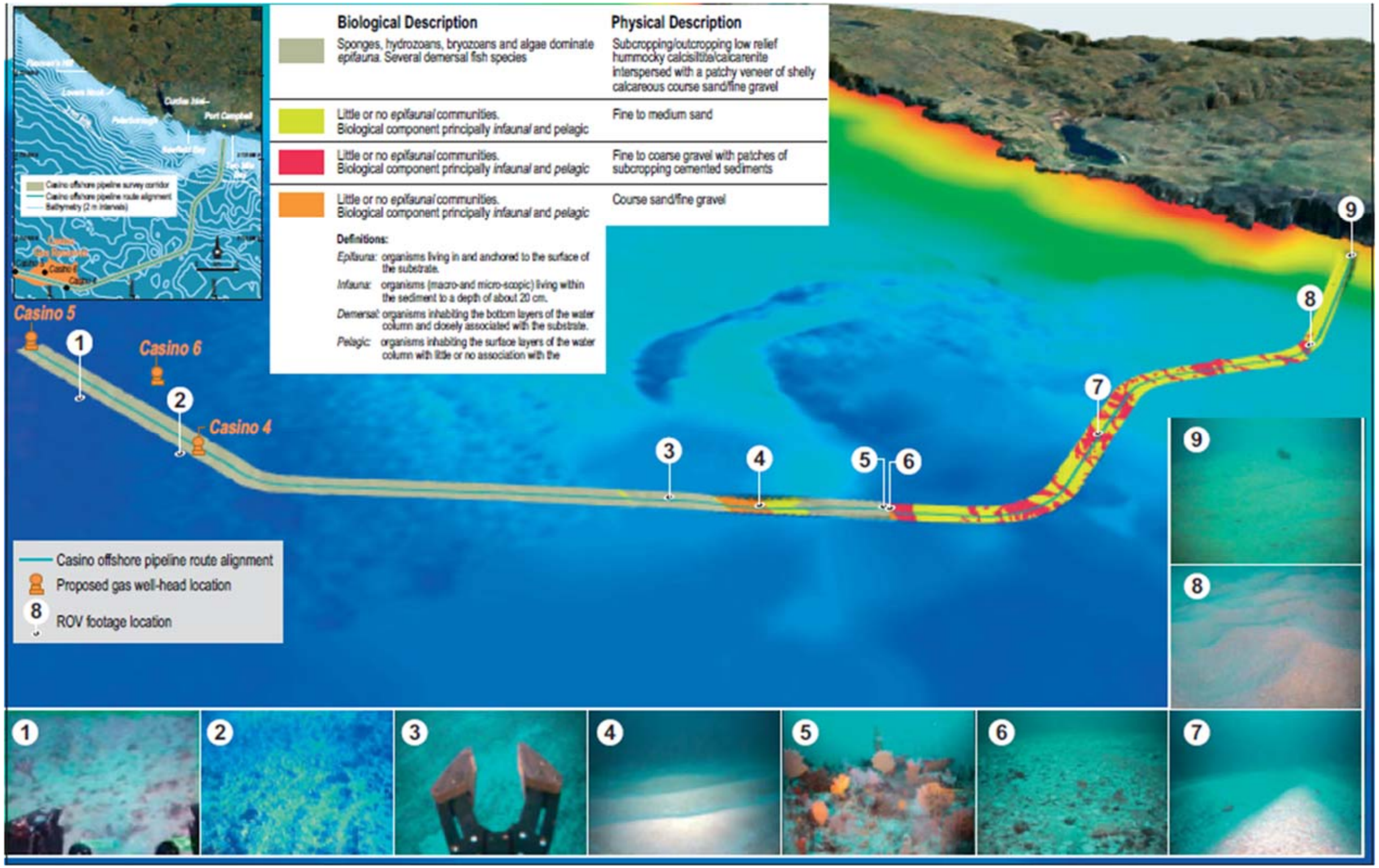
The offshore pipeline traverses mainly sandy seabed and occasionally patchy sponge gardens of varying density cover. The alignment was selected to avoid environmental impacts to significant environmental features such as nearshore and significantly raised relief reef habitats. The shore-crossing, installed by HDD, also avoided key impacts to near-shore reefs and coastal habitats (Santos, 2004). The HDD exit point is in 18 m water depths.

The following benthic environments occur between the shore and the well sites, based on ROV surveys conducted in 2004 for the development phase of the Casino project (Santos, 2004):

- Intertidal environment (0 to 2 m):
  - Rock platform.
  - Cliff face.
  - Sandy beach.
- Shallow environments (2 to 8 m):
  - Contiguous kelp reefs.
  - Patch sandy reefs.
  - Sand.
- Mid-depth environment (8 to 20 m):
  - *Eklonia*-dominated reef.
  - Sand
- Deep environment (20 to 70 m):
  - Sponge-dominated reef.
  - Sand.

The mid-depth and deep environment habitats are described in more detail below. Figure 4-3 illustrates the benthic habitats along the Casino pipeline.

Figure 4-3: Seabed Habitat Classification of the Casino Pipeline



Mid-Depth Environment (8-20 m)

The mid-depth environment is the most extensive and is relatively uniform throughout the region and is dominated by sand. The open sand environment comprises a range of grain sizes although sand is usually finer and sand waves of lower crest height and inter-crest distance than in the shallower environment. BHP–Santos (1999) identified intermittent patch reefs dominated by the brown alga, *Ecklonia* sp. Red algae and coralline algae were also identified, in addition to epifauna including echinoderms, ascidians, bryozoans and sponges. These isolated reefs probably represent centres of high species diversity and abundance of epifauna and fish compared to the open sand (Santos, 2004).

Deep Environment (20-70 m)

Much of the seabed traversed by the proposed pipeline from the HDD point to approximately 60 m water depth is classified as sand or fine gravel. No epifauna were observed in these large tracts of sand and the biological component is likely to be primarily in-faunal or pelagic.

Beyond 60 m water depth, extending out to the well sites, the seabed is characterised by concreted outcroppings with very low relief and structural complexity separated by gullies of sand or fine gravel. Survey footage from one location in 2003 (KP15.70) and two locations surveyed in 2002 (refer Figure 4-3, Locations 1 & 2) indicate that this broad flat area has a sparse cover of filter-feeding epifauna dominated by sponges and also probably hydrozoans, bryozoans and algae. Some small fish species were also observed at the well sites.

This large area of sparse epifauna cover is differentiated by a more abundant and diverse reef feature identified at KP19.5 which is biologically classified as sponge reef habitat with diverse epifauna consisting of sponges, hydrozoans, bryozoans and algae. Fish species identified in video footage at this location included magpie morwong (*Cheilodactylus nigripes*), blue-throated wrasse (*Notolabrus tetricus*), gurnard (*Neobastes scorpaenoides*), goatfish (probably *Upeneichthys vlamingil*) butterfly perch (*Caesioperca lepidoptera*) and another wrasse species that could not be identified. The sponge reef habitat also represents the only potential abalone and rock lobster habitat along the pipeline route. The sponge reef at KP19.50 is localised and isolated and does not cover a large area (Santos, 2004).

While it is confirmed that a sponge reef habitat occurs at KP19.5, sponges and epifauna may also occur, albeit in reduced density and diversity, intermittently along the pipeline alignment between KP19.5 and the well sites. Additionally, kelp-dominated reef that is known to occur in the region does not appear to be a feature along the pipeline alignment as covered by the acoustic survey (Santos, 2004).

A side-scan survey of the proposed Otway gas pipeline (adjacent to the Casino pipeline) undertaken by Woodside (2003) revealed patches of soft seabed in various locations, with the sand being coarse and containing mega-ripples. Given the nature of the highly mobile sand, there is likely to be an inherent temporal and special variability of infauna and epibiota. Woodside (2003) also reported that the nearshore sediments are too mobile for the establishment of fixed biota such as seagrasses, with studies for the Minerva Gas Development also concluding there were no seagrasses in the area (Woodside, 2003).

The same survey identified that the intermittent nearshore rocky reefs (in waters less than 18 m deep) along this section of coastline are characterised by an abundance of brown kelps, with a diverse understorey of red, green and brown seaweeds, sea squirts, sponges, bryozoans, crustaceans and molluscs that are widely represented along the Victorian coast (Woodside, 2003). This aligns with the description provided for the Casino pipeline detailed above. Weedy and leafy sea-dragons are known to be associated with this habitat, though exact species are not known and those listed under the EPBC Act Protected Matters Search for the EMBA includes species known to inhabit the entire Australian southern coastline.

4.2.2 Pelagic Environment (Protected Species)

A search of the Commonwealth Department of Environment and Energy's (DoEE) Environment Protected Matters database (2016a) was undertaken for the CHN 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 CHN EMBA

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
FISH						
Carcharodon carcharias	Great white shark	Vulnerable, Migratory	Threatened	Recovery Plan for the White Shark (SEWPC, 2013)	✓ [Known Distribution Area for species]	No threats applicable to CHN activities
Isurus oxyrinchus	Shortfin mako shark	Migratory	-	-	X	-
Lamna nasus	Porbeagle shark	Migratory	-	-	X	-
Prototroctes maraena	Australian grayling	Vulnerable	Threatened	National recovery plan for the Australian Grayling (DEWHA, 2008)	X	No threats applicable to CHN activities
CETACEANS						
Balaenoptera acutorostrata	Minke whale	Migratory	Threatened	-	X	-
B. bonaerensis	Antarctic minke whale	Migratory	-	-	X	-
B. borealis	Sei whale	Vulnerable, Migratory	-	Sei Whale TSSC Conservation Advice (2015b)	X	Assess anthropogenic impacts to sei whales and identify mitigation measures Assess and adopt measures to minimise and report cetacean strikes
B. edeni	Bryde's whale	Migratory	-	-	X	-
B. musculus	Blue whale (pygmy)	Endangered, Migratory	Threatened	Blue whale Conservation Management Plan (DoE, 2015a)	✓ [Known Foraging Area for species]	Assess and reduce anthropogenic noise associated with IMR activity Report collisions to regulators and adopt measures to minimise collisions

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
B. physalus	Fin whale	Vulnerable, Migratory	-	Fin Whale TSSC Conservation Advice (2015cb)	X	Assess anthropogenic impacts to fin whales and identify mitigation measures Assess and adopt measures to minimise and report cetacean strikes
Berardius arnuxii	Arnoux's beaked whale	Migratory	-	-	X	-
Caperea marginata	Pygmy right whale	Migratory	-	-	X	-
Eubalaena australis	Southern right whale	Endangered, Migratory	Threatened	Conservation Management Plan for Southern Right Whale (SEWPC, 2012a)	✓ [Aggregation, Migratory]	Assess impacts and mitigation measures with respect to vessel use Adopt measures to minimise cetacean strikes.
Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory	Threatened	Humpback Whale TSSC Conservation Advice (2015a)	X	Threat abatement Plan (marine debris) will be applied in EP. Assess and adopt measures to minimise cetacean strikes.
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 (CoA, 2017)	X	Implement legislative requirements for garbage discharge Integrate oil pollution plans with National Plan requirements
Chelonia mydas	Green turtle	Vulnerable, Migratory	-		X	
Dermochelys coriacea	Leatherback turtle	Endangered, Migratory	Critically Endangered		X	
BIRDS						

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
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 epomophora	Southern royal albatross	Vulnerable, Migratory	Threatened	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	Threatened	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Diomedea sanfordi	Northern royal albatross	Endangered, Migratory	-	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Haliaeetus leucogaster	White-bellied sea-eagle	-	Threatened	-	X	-
Halobaena caerulea	Blue petrel	Vulnerable	-	Approved Conservation Advice for *Halobaena caerulea* (blue petrel). (TSSC, 2015d)	X	-
Macronectes giganteus	Southern giant-petrel	Endangered, Migratory	Threatened	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	Threatened	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Morus serrator	Australasian gannet	Migratory	-		✓ [Foraging Area for species]	-
Pachyptila turtur subantarctica	Fairy prion (southern)	Vulnerable	-	-	X	-
Phoebetris fusca	Sooty albatross	Vulnerable, Migratory	Threatened	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	-

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	-	Commonwealth Conservation Advice on *Pterodroma Mollis* (Soft plumaged petrel) (TSSC, 2015f)	-	No threats applicable to CHN activities
Puffinus carneipes	Flesh-footed shearwater	Migratory	-	-	X	-
Thalassarche bulleri	Buller's albatross	Vulnerable, Migratory	Threatened	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 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	Threatened	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	Threatened	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, Migratory	-	National Recovery Plan for threatened albatrosses and giant petrels 2011-2016 (SEWPC, 2011)	X	Evaluate marine debris risk to species
Shorebirds/Coastal Wetland Species						
Arenaria interpres	Ruddy turnstone	Migratory	-	-	X	-

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
Calidris alba	Sanderling	Migratory	-	-	X	-
Calidris canutus	Red knot	Endangered Migratory	-	Approved Conservation Advice for *Calidris canutus* (Red Knot) (TSSC, 2016a)	-	Pollution threats Manage disturbance activities (vehicle access, etc.) at important sites
Calidris ferruginea	Curlew sandpiper	Critically Endangered, Migratory	Threatened	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	X	Pollution threats Manage disturbance activities (vehicle access, etc.) at important sites
Charadrius bicinctus	Double-banded plover	Migratory	-	-	X	-
Charadrius mongolus	Lesser sand plover	Endangered Migratory	-	Approved Conservation Advice for *Charadrius mongolus* (Lesser Sand Plover) (TSSC, 2016b)	X	Pollution threats Manage disturbance activities (vehicle access, etc.) at important sites
Heteroscelus breviceps	Grey-tailed tattler	Migratory	Threatened	-	X	-
Pandion haliaetus	Osprey	Migratory	-	-	X	-
Pluvialis fulva	Pacific golden plover	Migratory	-	-	X	-
Sterna albifrons	Little tern	Migratory	Threatened	-	X	-
Sterna bergii	Crested tern	Migratory	-	-	X	-
Sternula nereis nereis	Australian fairy tern	Vulnerable	Threatened	Commonwealth Conservation Advice on *Sternula nereis nereis* (Fairy Tern) (TSSC, 2011)	X	Ensure relevant management measures are adopted during any spill response activities which require shoreline access.

Scientific Name	Common Name	EPBC Act Status (Com)	FFG Act Status (Vic)	Management Plan/ Recovery Plan and Approved Conservation Advice	Presence of BIA	Relevant Management Actions
Thinornis rubricollis	Hooded plover	Vulnerable	Threatened	Conservation Advice for *Thinornis rubricollis rubricollis* hooded plover (eastern) (TSSC, 2014)	X	Manage the use (and access to) key beaches when plovers are breeding. Prepare oil spill response plans to ensure effective rehabilitation of oiled birds. Reduce in-shore marine debris.

4.3 Conservation Values

4.3.1 Commonwealth Marine Reserves

The CHN EMBA intersects the Apollo Commonwealth Marine Reserves (CMR) approximately 70 km southeast of the CHN assets.

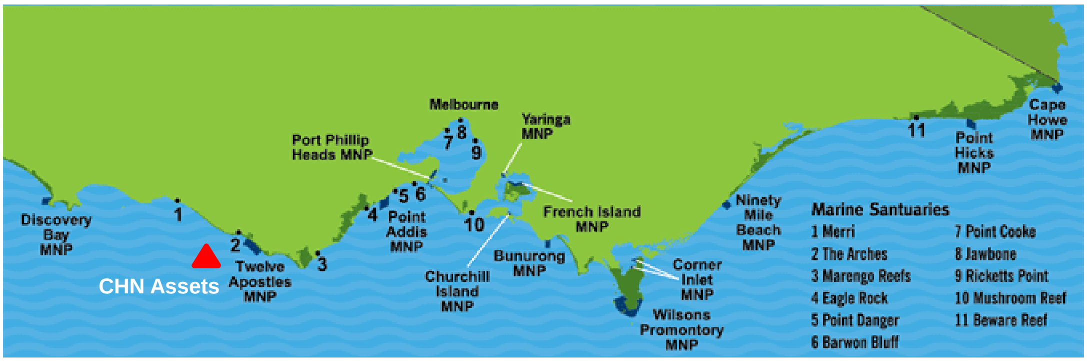
4.3.2 Victorian Marine Reserves

The CHN EMBA intersects the following Victorian marine reserves:

- Twelve Apostles Marine National Park approximately 13 km east southeast of CHN assets;
- The Arches Marine Sanctuary approximately 3 km south east of CHN assets;
- Merri Marine Sanctuary approximately 37 km northwest of CHN assets;
- Marengo Reefs Marine Sanctuary approximately 64 km east southeast of CHN assets;
- Eagle Rock Marine Sanctuary approximately 102 km east-northeast of CHN assets; and
- Point Addis Marine National Park approximately 107 km east-northeast of CHN assets.

Figure 4-4 provides the location of these marine reserves.

Figure 4-4: State Marine Reserves



4.3.3 Victorian Terrestrial Reserves

The CHN EMBA intersects the following Victorian terrestrial reserves (shoreline):

- Port Campbell National Park on shoreline adjacent to CHN assets;
- Bay of Islands Coastal Park approximately 8 km west of CHN assets; and
- Great Otway National Park approximately 18 km south east of CHN assets.

4.3.4 Key Ecological Features

The CHN EMBA intersects the Bonney Upwelling Key Ecological Feature (KEF) and is located approximately 53km west northwest of the CHN assets. It also intersects areas which may contain the “Shelf Rocky Reef and Hard Substrates” KEF identified in the South-east Regional Profile.

The location of the Bonney Upwelling KEF relative to the CHN assets is provided in Figure 4-5.

Figure 4-5: Key Ecological Features in proximity to CHN Assets

Bonney Upwelling

The Bonney Upwelling is an oceanographic upwelling of cold, nutrient rich water typically occurring in the summer and autumn along the narrow continental shelf between Robe, SA, and Portland, Victoria. Surface expression of the upwelling is only intermittent further to the southeast where the shelf is wider. The Bonney Upwelling generally starts in the eastern part of the Great Australian Bight in November/December and spreads eastwards to the Otway Basin around February (Gill et al., 2011).

The primary ecological importance of the Bonney Upwelling is as a feeding area for the blue whale (*Balaenoptera musculus*). The upwelled nutrient-rich water promotes blooms of coastal krill (*Nyctiphanes australis*), which in turn attracts blue whales to the region to feed. As described in the Conservation Management Plan for the Blue Whale – A Recovery Plan under the EPBC Act 1999 (DoE, 2015a), the Bonney Upwelling, defined as occurring from Robe (SA) to Cape Otway (Victoria), is a known feeding aggregation area for blue whales during November to April and is only one of three identified feeding areas consistently used by blue whale in Australian coastal waters (Butler et al., 2002).

The high productivity of the Bonney Upwelling also leads to algal diversity and its productivity as a fishery. This productivity leads to the presence of higher predator species such as little penguins (Collins *et al.,* 1999) and fur seals feeding on baitfish.

Shelf Rocky Reefs and Hard Substrates

Rocky reefs and hard grounds are located in all areas of the south-east marine region from the sub-tidal zone shore to the continental shelf break. The shallowest depth at which the rocky reefs occur in Commonwealth waters is approximately 50 m. The KEF is an area of high productivity with aggregations of marine life and has not been spatially defined.

On the continental shelf, rocky reefs and hard substrates provide attachment sites for macro-algae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity (DoE, 2015b).

This KEF may be present in the deeper areas of the CHN EMBA area (in depths >60 m based upon pipeline alignment surveys).

4.3.5 Threatened Ecological Communities

Threatened Ecological Communities (TECs) provide wildlife corridors and/or habitat refuges for many plant and animal species. The giant kelp marine forests of South East Australia are the only listed marine TEC (endangered) which may occur in the EMBA and is protected under the EPBC Act. The terrestrial Subtropical and temperate coastal saltmarsh TEC, listed as vulnerable is also listed as likely to occur in the area.

Giant Kelp Marine Forests of South-East Australia:

Giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs from the sea floor 8 m below sea level and deeper. Its fronds grow vertically toward the water surface, in cold temperate waters off southeast Australia. The kelp species itself is not protected, rather, it is communities of closed or semi-closed giant kelp canopy at or below the sea surface that are protected (SEWPC, 2012b).

Giant kelp is the largest and fastest growing marine plant. Their presence on a rocky reef adds vertical structure to the marine environment that creates significant habitat for marine fauna, increasing local marine biodiversity. Species known to shelter within the kelp forests include weedy sea dragons (*Phyllopteryx taeniolatus*), six-spined leather jacket (*Mesuchenia freycineti*), brittle star (*Ophiuroid sp*), urchins, sponges, blacklip abalone (*Tosia spp*) and southern rock lobster (*Jasus edwardsii*). The large biomass and productivity of the giant kelp plants also provides a range of ecosystem services to the coastal environment. Giant kelp is a cold-water species and requires clear, shallow water no deeper than 35 m. As sea surface temperatures have risen on the east coast of Australia over the last 40 years, it has been progressively lost from its historical range. The largest extent of the ecological community is in Tasmanian coastal waters. Some patches may also be found in Victoria and South Australia.

James et al (2013) undertook extensive surveys of macroalgal communities along the Otway Shelf from Warrnambool to Portland in southwest Victoria. These surveys did not locate giant kelp at any site but identified that other brown algae species prolific to around 20 m water depth.

Surveys of The Arches Marine Sanctuary (Edmunds et al., 2010) and Twelve Apostles Marine National Park (Barton et al., 2012) have not located giant kelp. The species has been recorded in Discovery Bay National Park (approximately 150 km west of the CHN assets) and an assemblage dominated by the species has been recorded from Merri Marine Sanctuary (37 km west of the CHN assets) occupying a very small area (0.2 ha) of rocky reef (Barton et al., 2012).

Subtropical and Temperate Coastal Saltmarsh

This TEC occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coasts. It is typically found on sandy or muddy substrate and may include coastal clay pans or similar areas. It occurs in places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences. The ecological community may also include areas that have groundwater connectivity to tidal water bodies (TSSC, 2013).

The ecological community consists of dense to patchy areas of mainly salt-tolerant vegetation (halophytes) including: grasses, herbs, sedges and shrubs that may also include bare sediment as part of the mosaic). It is inhabited by a wide range of in-faunal and epi-faunal invertebrates such as prawns fish and birds. It often constitutes an important nursery habitat for fish and prawn species and insects are abundant.

Boon et al. (2011) undertook field studies to confirm areas of coastal saltmarsh. Locations identified within the CHN EMBA include:

- Fawthrop Lagoon (Portland) (approx. 120 km WNW);
- Eumerella River estuary (Lake Yambuk) (approx.85 km WNW);
- Moyne River estuary (Port Fairy termed Belfast Lough): (approx. 70 km NW);
- Merri River (Warrnambool) (approx. 50 km NW);
- Port Campbell Creek (approx. 3 km east);
- Painkalic Creek (Aireys Inlet) (approx.110 km east);
- Angelsea River (approx.118 km east).

4.3.6 Other Matters of National Environmental Significance (NES)

Other matters of national environmental significance with respect to the CHN assets are as follows:

- *World Heritage Properties:* There are no World Heritage Properties in the EMBA. The closest sites are onshore in Melbourne (Royal Exhibition Building and Carlton Gardens), Victoria (193 km northeast) and Naracoorte (Australian Fossil Mammal site), South Australia (260 km northwest).

  National Heritage Places: The nearest places of National Heritage to the CHN assets are all located onshore and do not have marine or shoreline components. These are:

  - Great Ocean Road;
  - Budj Bim National Heritage Landscape (Mt Eccles Lake Condah Area) – located 100 km northwest; and
  - Budj Bim National Heritage Landscape (Tyrendarra Area) – located 102 km west-northwest.

- *Wetlands of International Importance*: There are no marine or coastal Wetlands of International Importance (RAMSAR-listed wetlands) in the EMBA. The closest sites are Livinia on King Island (141 km southeast) and the Western District Lakes (50 km northeast).

4.4 Cultural Heritage

4.4.1 Historic Shipwrecks

The stretch of coastline adjacent to the CHN assets is known as the ‘Shipwreck Coast’ because of the number of shipwrecks present with most wrecked during the late nineteenth century. The wrecks represent significant archaeological, educational and recreational (i.e., diving) opportunities for locals, students, and tourists (Flagstaff Hill, 2015). Shipwrecks closest to the CHN assets are listed below (Victorian Heritage Database, 2016):

- *Napier* – wrecked in 1878, is located 3 km east of the Casino pipeline.
- *Nowra* – wrecked in 1891 and was driven onto the ‘London Bridge’ rocks.
- *Newfield* – wrecked in 1892, is located 6.5 km west of the Casino pipeline.
- *Young Australian* – wrecked in 1877 at Curdies Inlet.
- *Schomberg* – wrecked in 1855 at Curdies Inlet is located 7 km west of the Casino pipeline.
- *Falls of Halladale* – wrecked in 1908 is located 9 km southeast of the Casino pipeline.
- Unnamed – located west of Peterborough in waters less than 10 m deep.
- *Loch Ard* – wrecked in 1878 is located 10 km west of the Casino pipeline.

None of the shipwrecks on the Victorian west coast are covered by shipwreck protected zones declared under Section 103 of the *Victorian Heritage Act 1995* (DELWP, 2016), The Australian National Shipwreck Database indicates there are no historic shipwreck protection zones near the CHN assets or within the EMBA.

4.4.2 Aboriginal Heritage

Aboriginal groups inhabited the southwest Victorian coast. During recent ice age periods, sea levels were significantly lower and the coastline was a significant distance seaward of its present location, enabling occupation and travel across land that is now submerged.

Coastal Aboriginal heritage sites include mostly shell middens, some stone artefacts, a few staircases cut into the coastal cliffs, and at least one burial site. The various shell middens within the Port Campbell National Park and Bay of Islands Costal Park are close to coastal access points that are, in some cases, now visitor access points (ParksVic, 1998).

4.5 Socio-Economic Environment

4.5.1 Settlements

The coastal communities of Apollo Bay, Princetown, Port Campbell, Peterborough, Warrnambool, Port Fairy and Portland all provide services to the commercial and recreational fishing industries in southwest Victoria. Portland is Victoria's western-most commercial port, and is a deep-water port with breakwaters sheltering a marina and boat ramp. The Port of Warrnambool has a breakwater and yacht club, and provides shelter for commercial fishing boats. Port Fairy has both harbour and fish processing facilities, but is not suitable for use by large vessels, nor is Port Campbell.

Port Campbell is the nearest town to the CHN assets. At the time of the 2011 census, the population of Port Campbell was 618. The town has a median age of 37, a median weekly household income of $1,097 and an unemployment rate of 5.4% (ABS, 2016). Dairy cattle farming is the town's largest employment type (19.3%), followed by tourist accommodation (10.6%), sheep, beef and grain farming (5%) and cafes, restaurants and food services accounting for 4.7% (ABS, 2016).

4.5.2 Tourism

Tourism is extremely valuable to the local and regional economy. Key activities include sight-seeing, surfing and fishing however, these are generally land-based or near-shore activities and are not impacted by the CHN asset operations.

The CHN assets are located in an area of the Otway coastline located on the Great Ocean Road, one of the most famous drives in the world. In 2013-14 most visitors were from intrastate market (82%) followed by 12% from interstate.

A recent study identified that just over a third of international day visitors who visited the 12 Apostles only come to Victoria because of the opportunity to visit the 12 Apostles/Great Ocean Road area. A further 47% of international day visitors who visited the 12 Apostles responded that visiting the 12 Apostles/Great Ocean Road area was one of their top three reasons for visiting Victoria. Visitation to the Shipwreck Coast is estimated to have contributed between $712m and $782m in incremental visitor spending to Victoria in 2015.

Tourist numbers peak in the area between mid-December and Chinese New Year (mid-February) in the area, with tourist numbers still high in the shoulder periods between mid-February and end April; and November to mid-December (pers. com. M. Cuttle, Port Campbell Visitor's Centre, 2017).

4.5.3 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.

Agricultural products and woodchips are transported from the Port of Portland to receiving ports in the Gulf of St Vincent, South Australia, and through Bass Strait to Melbourne and Sydney (NOO, 2004). There are also numerous minor shipping routes in the area, such as those that service King Island.

AMSA indicates that there are no designated shipping lanes in the vicinity of the CHN assets, however local commercial fishing vessels utilise the area frequently. Review of shipping data for the area indicates the highest density shipping occurs in the southern-most part of Vic/L30 and Vic/L24. The CHN assets are located at the northern extremity of areas with high traffic volumes.

The main shipping channel for vessels (e.g., cargo tankers) travelling between Australian and foreign ports is located south of the CHN assets, about 75 km (40 nm) south of Warrnambool. This shipping channel is used by over 1,000 vessels per year, or about 3-4 vessels per day.

4.5.4 Commercial Fishing

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

4.5.5 Recreational Fishing

Recreational fishing includes rock, beach, boat and estuary fishing, using rod and line. Common inshore fish species caught by recreational fishers include sand flathead (*Platycephalus bassensis*), John dory (*Zeus faber Linnaeus*), jackass morwong (*Namadactylus macropterus*), silver trevally (*Pseudocaranx dentex*), snapper (*Pagrus auratus*), barracouta (*Thyrsites atun*) and mullet (*Aldrichetta forsteri*). Common species caught at Curdies Inlet include black bream (*Acanthopagrus but*cheri), estuary perch (*Macquaria colonorum*), mullet (*Aldrichetta forsteri*) and Australian salmon (*Arripis sp*.) (BHP-Santos,1999).

Fishing charter operators provide deeper water recreational fishing opportunities (such as tuna fishing).

Table 4-2: Commercial Fisheries operating in the CHN EMBA

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
COMMONWEALTH FISHERIES						
Bass Strait Central Zone Scallop Fishery	Scallops (*Pecten fumatus*).	**No**.	**No**.	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.	2 - 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 but prefers water depth of 70-80 m. 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)

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
Skipjack Fishery (Eastern) (Sub-area 03, southern inshore area)	Skipjack tuna (*Katsuwonus pelamis*).	**No**. No fishing effort in the fishery 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. There were 18 fishing permits for the 2014-15 fishing season, 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 (western sub-area)	Jack mackerel (*Trachurus declivis, T. symmetricus, T. murphyi*) Blue mackerel (*Scomber australasicus*), Redbait (*Emmelichthys nitidus*) and Australian sardine (*Sardinops sagax).*	**No**. Fishery effort concentrated in the near-shore GAB (west of Port Lincoln and Kangaroo Island). Eastern sub-area effort is concentrated in far southern NSW and Tasmania (2015-16 data).	**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 purse seine and 1 mid-water trawl vessels active.	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)
SESSF – CTS & Danish Seine	Blue grenadier (*Macruronus novaezelandiae*), tiger flathead (*Platycephalus richardsoni*), pink ling (*Genypterus blacodes*) silver warehou (*Seriolella punctata*).	**Unlikely (CTS)** **No (Danish Seine)** Trawl sector is concentrated around shelf-break areas. Danish seine activity is located on the continental shelf and operate in sandy bottom environments.	**Unlikely (CTS)** **No (Danish Seine)**	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)

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
SESSF – Shark Gillnet and Shark Hook sector	Elephantfish (*Callorhinchus milii*) Gummy shark (*Mustelus antarcticus*) Sawshark (*Pristiophorus cirratus*, *P. nudipinnis*)	**Possible (Gillnet)** **No (Hook)** Gillnet sector heavily utilises the continental shelf. Hook sector does not fish in the Gippsland Basin.	**Possible (Gillnet)** **No (Hook)**	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 2015-16 fishing season, there were 89 fishing permits with 6 active purse seine vessels and 18 longline vessels.	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 to April. Value of Fishery: $36.8M (2014-5)

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
Southern Jig Squid Fishery	Arrow squid (*Nototodarus gouldi*).	**No**. Data indicates that fishing is concentrated along the 200 m bathymetric contour with highest fishing intensity south of Portland and Warrnambool. Commonwealth fishery does not operate in Victorian State waters.	**Possible**. Catches are concentrated in Commonwealth waters between Portland and Robe (SA).	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						

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
Rock Lobster Fishery	Predominantly southern rock lobster (*Jasus edwardsii*), along with small quantities of eastern rock lobster (*Jasus verreauxi).*	**Yes.** VRLA advises that fishing occurs throughout the area on rocky reefs.	**Yes.**	71 licences in the Western zone, permitted to use baited rock lobster pots. In 2014/5, there were 48 active licences and 47 vessels working in the western zone. In 2014/15, 224 tonnes were harvested in the western 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 western zone indicates fishing occurs year-round, with catches being much reduced during May, June & July, and highest catches occurring from November to February.	Assets covered by Western Zone (Apollo Bay to the SA/Vic 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*).	**Unlikely**. Although concentrated on the continental shelf, given that licence holdings are linked to southern rock lobster licences, there may be some fishing.	**Unlikely**.	Giant crabs can only be taken using commercial rock lobster pots by Western Zone lobster fishers. In 2013/14 there were 30 licenses within the fishery. Fished mostly on the shelf break (150-350 m water depth).	Assets covered by Western Zone (Apollo Bay to the SA/Vic border) and south to 40^{o}S.	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 round prohibition on the retention of berried females. Value of Fishery: $0.6M (2015)

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) and greenlip abalone (*Haliotis laevigata*).	**Likely**. Abalone diving activity occurs close to shoreline (generally to depths of 30 m on rocky reefs) and may operate around the assets.	**Yes.**	The fishery consists of 71 fishery access licences of which 34 operate in the Victorian Central Zone. Commercial fishing methods use diving equipment such as a surface air supply to the diver (hookah system) from small high speed fishing boats. Diving is normally to depths less than 20 m.	Victorian Central Abalone Zone is located between Lakes Entrance and the mouth of the Hopkins River.	Green lip abalone spawns between October and February. Blacklip abalone spawns between February and April and again between October and December. Total TACC is 806 tonnes with landed value $20M (2009/10 prices) (SIV, 2017)
Scallop Fishery	Scallop (*Pecten fumatus*).	**No** Mostly fished from Lakes Entrance and Welshpool.	**No**.	A total of 91 commercial licenses are issued each year and approximately 10-15 vessels operate within the fishery. Commercial vessels tow a single dredge that is dragged along the seabed. Dredges are deployed from the rear of the vessel, and are up to 4.5 metres wide.	Extends 20 nm south of the Victorian coastline.	The fishery is not opened unless the abundance of scallops in specific locations meets the agreed criteria for the average number of scallop meats per kilogram. A total allowable commercial catch (TACC) is set annually for the period 1 April to 31 March (following year). In the past two seasons, 2010/11, 2011/12 and 2012/13 there was a zero TACC for the Victorian Scallop Fishery. A small conservative quota was in place for the 2013/4 season of 136.5 tonnes and for 2014/5 of 135 tonnes. Value of Fishery: Not available

Fishery	Target species	Does fishing activity intersect CHN assets?	Intersects EMBA?	Fishing methods and permits	Location	Notes
Rock Lobster Fishery	Predominantly southern rock lobster (*Jasus edwardsii*), along with small quantities of eastern rock lobster (*Jasus verreauxi).*	**Yes.** VRLA advises that fishing occurs throughout the area on rocky reefs.	**Yes.**	71 licences in the Western zone, permitted to use baited rock lobster pots. In 2014/5, there were 48 active licences and 47 vessels working in the western zone. In 2014/15, 224 tonnes were harvested in the western 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 western zone indicates fishing occurs year-round, with catches being much reduced during May, June & July, and highest catches occurring from November to February.	Assets covered by Western Zone (Apollo Bay to the SA/Vic 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*).	**Unlikely**. Although concentrated on the continental shelf, given that licence holdings are linked to southern rock lobster licences, there may be some fishing.	**Unlikely**.	Giant crabs can only be taken using commercial rock lobster pots by Western Zone lobster fishers. In 2013/14 there were 30 licenses within the fishery. Fished mostly on the shelf break (150-350 m water depth).	Assets covered by Western Zone (Apollo Bay to the SA/Vic border) and south to 40°S.	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 round prohibition on the retention of berried females. Value of Fishery: $0.6M (2015)

Sources: Commonwealth: *Patterson et al (2016); ABARES (2016) unless otherwise noted*; Victoria: Agriculture Victoria (2016) unless otherwise noted

4.5.6 Petroleum Exploration and Production

The Otway Gas Field Development, operated by Origin, is located 70 km south of Port Campbell. The development consists of a remotely operated platform (at Thylacine) (~35 km south of the Casino wells), offshore and onshore pipelines and a gas processing plant located 6.4 km northeast of Port Campbell. The Geographe and Thylacine fields together produce an average of 60 PJ of natural gas per year, along with 100,000 tonnes of LPG and 800,000 Bbl of condensate (Origin, 2016). Over its operating life, the development is expected to supply 950 billion cubic feet (bcf) of raw gas, 885 PJ of sales gas, 12.2 million barrels of condensate and 1.7 million tonnes of LPG to the market. The Thylacine/Geographe gas pipeline is located 1.8 km to the east of the northern (shallow water) portion of the Casino gas pipeline.

The Minerva Gas Development is operated by BHP Billiton and commenced production in April 2005. This project involved the drilling and installation of two subsea wells in shallow waters (60 m deep and 10 km from the coast), which were tied back to an onshore gas plant (4.5 km inland) via a single pipeline. The gas plant has the capacity to produce 150 TJ gas and 600 barrels of condensate per day. The Minerva gas pipeline is immediately adjacent to the northern portion of the Casino gas pipeline.

In 2016, Origin recently completed its Halladale and Blackwatch gas field development. The Halladale production well is located 13 km north of the Netherby production well. It was directionally drilled from an adjacent onshore location, with a pipeline laid between the onshore drill site and the Iona Gas Plant.

The North Paaratte Gas Plant and Heytesbury Gas Plant, located 8 km northwest of Port Campbell, are currently mothballed. They processed and distributed gas from onshore gas fields.

4.5.7 Defence Activities

The Defence Force 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.

Five training areas are located more than 150 km east of the CHN assets, in and around Port Phillip Bay and Western Port Bay.

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 ordnance (UXO), though these are located south and east of Wilson’s Promontory (350 km east of the CHN assets).

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 CHN operations activity 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 CHN operations 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 Cooper'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 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 Cooper's acceptance criteria.

For the CHN assets, environmental hazard identification and assessment considered the following:

- Activities that will occur during operations and the typical equipment and vessels 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 CHN operational activities during consultation.

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

Table 5-1: Definition of Consequence

Descriptor	Environment	Regulatory, reputation, community and media	Financial/Legal
5. Critical	Severe long-term impact on highly-valued ecosystems, species populations or habitats. Significant remedial/recovery work to land/water systems over decades (if possible at all).	Critical impact on business reputation &/or international media exposure. High-level regulatory intervention. Potential revocation of License/Permit. Operations ceased.	Catastrophic structural failure/damage/loss. Financial loss >$50 M. Public inquiry, major litigation, prosecution with damages/fines >$50 M. Custodial sentence for a Cooper Manager
4. Major	Extensive medium to long-term impact on highly-valued ecosystems, species populations or habitats. Remedial, recovery work to land or water systems over years (~5-10 years).	Significant impact on business reputation and/or national media exposure. Significant regulatory intervention. Operations ceased.	Major structural failure/ damage/loss. Financial loss >$25 M. Major litigation or prosecution with damages or fines of >$25 M + significant costs.
3. Moderate	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function. Remedial, recovery work to land/water systems over months/year.	Moderate to small impact on business reputation. Potential for state media exposure. Significant breach of regulations, attracting regulatory intervention.	Moderate structural failure/damage/loss. Financial loss >$10 M. Litigation or prosecution costing >$10 M. Investigation by regulatory body.
2. Minor	Localised short-term impacts to species/habitats of recognised conservation value but not affecting local ecosystem functioning. Remedial, recovery work to land, or water systems over days/weeks. No significant impacts to third parties.	Some impact on business reputation and/or industry media exposure. Breach of regulations - event reportable to authorities.	Minor structural failure/damage/loss Financial loss >$5 m Major breach of regulation with punitive fine Involvement of Senior Management
1. Negligible	Temporary localised impacts or disturbance to plants/animals. Nil to negligible remedial/recovery works on land/water systems.	Minimal impact on business reputation. Negligible media involvement. No regulatory breaches or reporting.	Insignificant structural failure/damage/loss. Financial loss <$5 m. Breach of regulation with investigation or report to specialist with possible prosecution and fine.

Table 5-2: Definition of Likelihood

Descriptor	Description
A. Almost certain	Common event, expected to occur in most circumstances within Cooper operations (i.e., several times a year).
B. Likely	Event likely to occur once or more during a campaign, ongoing operations or equipment design life.
C. Possible	Infrequent event that may occur during a campaign, ongoing operations or equipment design life.
D. Unlikely	Unlikely event, but could occur at sometime within Cooper operations (has occurred previously in similar industry).
E. Remote	Rare event. May occur in exceptional circumstances of Cooper operations (not heard of in recent similar industry history).

Table 5-3: Cooper Qualitative Risk Matrix

		CONSEQUENCE				
		1.Negligible	**2.Minor**	**3.Moderate**	**4.Major**	**5.Critical**
LIKELIHOOD	**A. Almost Certain**	M	M	H	H	H
	B. Likely	M	M	M	H	H
	C. Possible	L	M	M	H	H
	D. Unlikely	L	L	M	M	H
	E. Remote	L	L	L	M	M

Table 5-4: ALARP determination for impact (consequence) and risk

IMPACT	NEGLIGIBLE	MINOR	SIGNIFICANT	MAJOR	CRITICAL
	Broadly acceptable	Tolerable if ALARP			Intolerable
RISK	LOW	MEDIUM			HIGH
	Broadly acceptable	Tolerable if ALARP			Intolerable

Table 5-5: Management response to impact and risk determinations

Category	Description & Response
HIGH	**Intolerable risk** (in particular at level A5 MAE) - Urgent Executive Management action immediately required, operations not to proceed without Executive Management oversight and approval. Unless specific corrective action(s) taken, possible curtailment of operations, isolate activity or task. Of material interest to the Board, Board advised of corrective action, project does not continue or commence without the support of the Board. Notification: Board of Directors (notified by Managing Director).
MEDIUM	**Tolerable if ALARP**, if all reasonably practicable risk reduction measures have been implemented. Local Senior Management responsibility and approval is required, if not yet ALARP, improve existing controls and/or implement new control(s) operational planning, management responsibility and actions must be specified, corrective & preventative action plan required. Notification: Managing Director (notified by Executive Management).
LOW	**Tolerable risk** that can be managed by routine procedures; accept risk. Senior Management/Supervisor decision required. Reporting & decision making at management level. Managed by routine Standard Operating Procedures (SOPs) and onsite management responsibility, approval and monitoring. Notification: Executive Manager (notified by Manager/Superintendent/Supervisor).

The following definitions for impact and risk assessment methodology:

- **Impacts** result from activities that by their very 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 *consequences* 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.

b) Uncertainty in impact/risk (shown diagrammatically in Figure 5-4). Based upon the level of uncertainty associated with the assessment of impact or risk, the following framework, adapted from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) provides the decision-making framework to establish ALARP. This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). The decision type is selected based on an informed decision around the uncertainty of the risk. Decision types and methodologies to establish ALARP are outlined in Table 5-6.

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

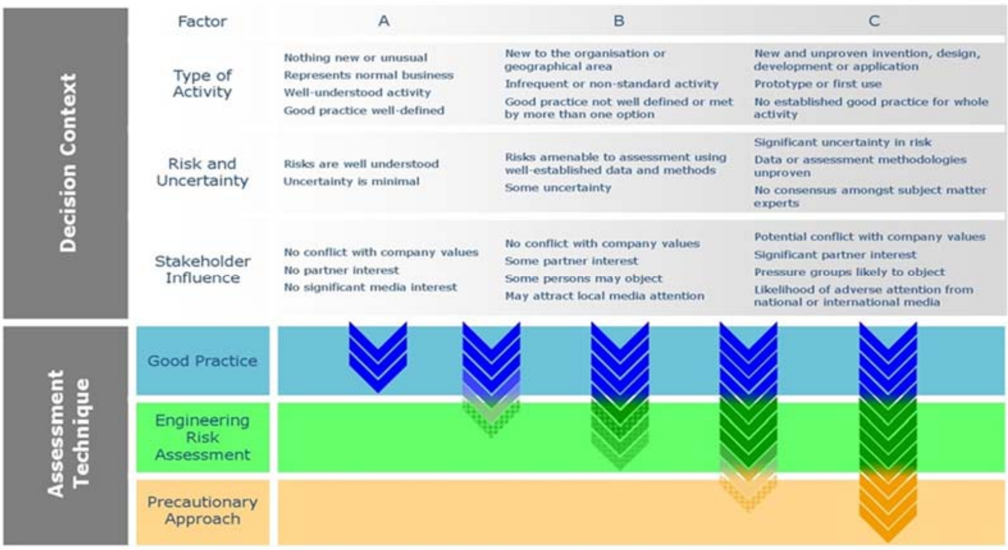


Table 5-6: ALARP decision-making based upon level of uncertainty

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 Cooper's Health, Safety, Environment and Community (HSEC) Policy.

Decision type	Description	Decision-making tools
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 external stakeholder consultation as part of the risk assessment process.	**Societal Values:** Identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder concerns as gathered through consultation.

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 5-7.

Table 5-7: 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)	Are 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 CHN operations activity 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: CHN Operations Environmental Impact and Risk Assessment Summary

#	Environmental Impact or Risk	Residual Impact or Risk Ranking
Impacts		
1	Discharge of Hydraulic Fluids	NEGLIGIBLE
2	Seabed Disturbance	NEGLIGIBLE
3	Discharge of gas	NEGLIGIBLE
4	Discharge of production chemicals	NEGLIGIBLE
5	Removal of marine growth from subsea infrastructure	NEGLIGIBLE
6	Underwater sound disturbance (vessel and helicopter)	MINOR
7	Atmospheric emissions (vessel)	NEGLIGIBLE
8	Light emissions (vessel)	NEGLIGIBLE
9	Treated sewage and greywater discharges (vessels)	NEGLIGIBLE
10	Cooling water and brine discharges (vessels)	NEGLIGIBLE
11	Putrescible waste discharges (vessels)	NEGLIGIBLE
12	Bilge water discharges (vessels)	NEGLIGIBLE
Risks		
13	Discharge of contaminated deck drainage	LOW
14	Production chemical release	LOW
15	Displacement of third-party vessels	LOW
16	Introduction of invasive marine species	MEDIUM
17	Vessel Strikes with megafauna	LOW
18	Accidental release of waste (vessels)	LOW
19	Loss of equipment to the environment	LOW
20	Condensate spill	LOW
21	Diesel spill (vessels)	LOW

6.1 IMR Campaign Timeframes (General)

A range of environmental receptors in the Otway basin are seasonally present or have seasonal sensitivities (i.e. spawning) and as such, environmental impact and risk depends upon their presence. The selection of IMR campaign timeframes can also reduce the impacts and risks of vessel-based activities.

As part of the pre-campaign planning a risk assessment will be undertaken to assess project, safety and environmental impacts and activity risks to ensure ALARP and acceptability criteria are met.

This process will involve personnel who can supply relevant information to the activity and/or are the key decision makers for the project. Information which will be included in the assessment includes:

- Vessel availability;
- Safe weather windows in which to operate;
- Seasonal environmental and socio-economic sensitivities within the region; and
- Location of the IMR activity against the expected location of these sensitivities.

The methodology to select the timeframe with the lowest environmental impact/risk associated with IMR activities will be done on a case-by-case basis as follows:

- The available activity windows (i.e. vessel availability and safe weather conditions) will be defined;
- For each sensitivity within that time window, identify the environmental and socio-economic impacts/risk of undertaking the activity in that period;
- Compare the environmental and socio-economic impacts for each period;
- From this comparison establish if there is a clear timeframe where impacts/risks to all environmental and socio-economic sensitivities can be minimised;
- If there is no clear timeframe the preferred timeframe will be defined by a qualitative comparison of severity of impacts and risks to sensitivities giving priority to:
  - Environmental sensitivities over socio-economic factors (refer below).
  - Threatened species over non-threatened species.

If timeframes are assessed as equally good, there may not be a preferred activity window between options available.

Socio-economic Factors:

- Commercial fishing has access to larger marine areas than the area occupied by the CHN facilities. CHN facilities have been aligned to avoid habitats where commercial fisheries operate. On the basis of this marine availability, Cooper considers that there is more flexibility in fishing options and fishing activities can exercise discretion as opposed to marine fauna.
- Impacts and risks from CHN activities are not expected to have substantial impacts to tourism in the area given the nature of the operations and hydrocarbon handled in the CHN facilities. Additionally, tourists visiting the Port Campbell area are attracted by its landscapes and scenery which will not be significantly impacted by the CHN operational risks identified.

6.2 Impact: Discharge of Hydraulic Fluids

6.2.1 Hazard

Hydraulic fluid is used to control subsea valves. Based upon data since 2013, total wellhead valve movements at the CHN wells has resulted the following annual releases of hydraulic fluid (approx.):

- 2013: 3,000 litres;
- 2014: 808 litres;
- 2015: 840 litres;

- 2016: 1382 litres.

No additional hydraulic fluids are released as part of the planned maintenance activities.

It is to be noted that due to the declining production of the asset, additional valve movements are required within the line to maintain flow assurance. It is possible that volumes may increase (perhaps by 100%) on an annual basis as a result of this altered production profile.

Valving which emits hydraulic fluid on the CHN facilities are located on the wellheads. The distance between Casino-4 and Casino-5 is 4.1 km, between Casino-5 and Henry-2 is 11.5 km and between Henry-2 and Netherby-1 is 3.2 km.

Each wellhead has the following valving and hydraulic release volumes (per closure) when actuated:

- Cross over Valve (XOV) – 0.58 litres;
- Annulus Chemical Injection Valve (ACIV) – 0.09 litres;
- Annulus Master Valve (AMV) – 0.58 litres;
- Chemical Injection Valve (CIV) – 0.09 litres;
- Chemical cross-over valve (CXOV) – 0.58 litres;
- Production Master Valve (PMV) – 2.98 litres;
- Production Wing Valve (PWV) – 2.98 litres;
- Subsurface Safety Valve (SSSV) – 0.058 litres: and
- Choke (PCV) – 0.019 litres.

Valve sequence movements and their release volume are provided below. ESD testing typically occurs one per year and well integrity testing twice per year. Controlled well shutdowns have been in the order of 10 per year. However as above flow assurance is likely to see more valve movements as production declines.

Valve Action	Valve Sequence	Released Volume
Emergency Shutdown (ESD)	All valves	7.957 litres
Controlled well shutdown	PMV, PCV, CIV	6.692 litres
Well Integrity Test (over 4-6 hours)	PCV, PWV, CIV, XOV, PMV, AMV, SSSV	27.128 litres

Well integrity testing, undertaken on a six-monthly basis, consists of a number of individual testes undertaken over a 4-6 hour period. Individual tests, together with the volumes of Transaqua HT2 emitted are provided in the Table below.

Test	Valves	Volume Emitted (litres)
SSSV Cycling	PWV, PCV, CIV, SSSV	5.866
XT Valve Test	PMV, AMV, CIV	3.65
Annulus Side Test	XOV, PWV, Choke	4.347
Production Side Test	PWV, XOV, CIV, Choke	3.912
PMV Test	PWV, Choke	3.504
PWV Test	PWV, CIV, PMV, Choke	6.504

6.2.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of the control fluid include a localised and temporary decrease in water quality. This will only occur in Commonwealth waters.

The environment affected for hydraulic fluid releases, given the intermittent nature of the release, the strong Otway Basin currents and their rapid dispersion characteristics, are expected to be localised around the release point.

Receptors that may occur within the affected environment, either as residents or migrants, are:

- Benthic fauna and filter feeding epifauna (e.g. sponges, macroalgae and other rocky hard substrate species such as bryozoans);
- Pelagic and demersal species (plankton, fin fish);
- Cetaceans; and
- Pinnipeds.

6.2.3 Evaluation of Environmental Impacts

Offshore valves primarily comprise pipeline and wellhead isolation valves designed to be fail-safe, that is, to close when there is no hydraulic pressure applied to keep them open. Wellhead control fluid is routinely discharged to sea when the valves close.

The volume released by each valve has been nominated above with a maximum valve release volume of 2.98 litres. The actuation of the valves is triggered by production changes and from periodic shut down testing of the pipeline control system, to confirm that the shutdown system is functioning satisfactorily. For any given valve closure sequence, the maximum volume emitted to the environment is approximately 27 litres (well integrity testing only over 4-6 hours). An ESD on each wellhead would result in 7.957 litres being released on each wellhead simultaneously, with each separated by at least 3.2 km. ESD actuation on wellheads is also infrequent.

Toxicity/Representative Species:

The control fluid currently used (Castrol Transaqua HT2) is a water-based fluid containing between 30-60% MEG and less than 5% triethanolamine. The product is ranked “D” under the non-CHARM OCNS ranking and meets Cooper Energy’s chemical selection criteria for toxicity, bioaccumulation potential and biodegradability. It is noted that the OCNS CHARM system assesses chemicals based upon their ‘No Observed Effect Concentrations (NOEC)’ which are derived from internationally recognised chronic-test procedures. For products which are not applicable to the CHARM model (i.e. inorganic substances, hydraulic fluids or chemicals used only in pipelines) an OCNS grouping is initially assigned according to the chemical’s toxicity. The toxicity tests adopted cover a significant period or test species lifecycle and are based upon a non-lethal endpoint. Tests included in the OCNS assessment methodology include an algal test (growth inhibition EC_{50}); crustacean (LC_{50} toxicity test) and larval fish test (LC_{50} toxicity test) (CEFAS, 2017a). Transaqua HT2 meets Cooper Energy’s chemical selection criteria of a non-CHARM OCNS ranking of “D’.

Species which have undergone testing for Transaqua HT2 include the following:

- Planktonic algae (*Skeletonema costatum*) a temperate species alga present in Victorian waters as well as North Sea waters. Toxicity (EC_{50} 72hrs) is between 1000 mg/l and 10,000 mg/l (Castrol, 2017);
- Copepod (*Acartia tonsa*) a temperate species crustacean which is listed as a low-risk invasive marine species and is present in Victorian waters. Toxicity (LC_{50} 48hrs) is >10,000 mg/l (Castrol, 2017);

- Copepod (*Gladioferens imparipes*) a temperate Western Australian crustacean species. Toxicity (LC_{50} 48hrs) is between 1000mg/l and 10,000 mg/l (Castrol, 2017).

No testing has been undertaken on species local to the Otway region however the planktonic algae (*Skeletonema costatum*) and copepod (*Acartia tonsa*) present in Victorian waters are considered representative species for Victorian temperate waters for eco-toxicity assessment purposes. Transaqua HT2 component testing has been undertaken on the North Sea temperate fish species *Scophthalmus maximus.* No equivalent testing has been undertaken with a temperate fish species for Australian waters. However component testing undertaken on *Scophthalmus maximus* identified that fish were less sensitive to Transaqua HT2 components for 99.7% of the formulation than the alga or copepod. On this basis product level testing on *Skeletonema costatum* and *Acartia tonsa* in considered to provide a protective toxicity threshold for assessment of the product.

Dispersion Distances:

Well head valving is typically located 2-3m from the seabed. Given the density of Transaqua HT2 (1.075 g/ml @ 15ºC) and its miscibility with water, the small volumes of this substance released will disperse and dilute rapidly in the seawater column currents. For the maximum identified release volumes of Transaqua HT2 (7.957 litres), screening calculations identify that for the most sensitive test species to Transaqua HT2 (marine alga), EC_{50} concentrations may be exceeded within 3.6 m of the wellhead for approximately 40 seconds. On this basis, species may be affected for temporarily, however exposure durations are not sufficient to realise the impacts for EC_{50} concentrations.

Little to no impact is expected on benthic fauna at the release location given the low toxicity, low bioaccumulation and biodegradability characteristics of the fluid, and the dispersion of the release. For seabed invertebrates present in the vicinity of the wellhead, it is possible that low-level concentrations of Transaqua HT2 may be present on a short-term and episodic basis, however given the low toxicity of the chemical, the low frequency and short-term nature of the exposure, negligible impacts are expected.

For mobile demersal and pelagic species which may be present at the wellheads during an ESD event, given the localised and short-term nature of the discharge, the low toxicity and low-frequency nature of the discharge and the species mobility which limits exposure, the environmental impact is expected to have a negligible impact to these species.

Impacts to Matters of NES:

The discharge of hydraulic fluids will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by the hydraulic fluid releases. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

6.2.4 Environmental Impact and Control Measure Summary

Aspect:	Operation of Valves (Discharge of Hydraulic Fluid)
Impact summary	Reduction in water quality and degradation of fauna habitat.
Extent of impact	Localised (immediately around wellhead).
Duration of impact	Temporary (minutes, (due to rapid dispersion and dilution).
Level of certainty of impact	HIGH. Hydraulic fluids are of low-toxicity.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to ensure hydraulic fluid discharges are low toxicity and minimised to the extent practicable include:

- *Hydraulic fluid selection*:
  - Only non-CHARM D/E or CHARM Gold/Silver category hydraulic fluids are used in accordance with Cooper chemical selection standards;
  - Cooper approved chemicals are reviewed on an annual basis to ensure the selected chemical meets Coopers chemical selection standards;
- *Wellhead valve function testing*: Valves are tested at nominated frequencies to ensure valves are operating efficiently;
- *Hydraulic fluid discharge monitoring*: Hydraulic fluid consumption is monitored on a daily basis to identify any unusual usage rates.

6.3 Impact: Seabed Disturbance

6.3.1 Hazard

The following activities have the potential to disturb the seabed:

- Dropped objects;
- Disturbance to infrastructure (storm damage, over trawl, etc.);
- Erosion/sediment build up along the pipelines and wellheads;
- Laying down of subsea infrastructure (e.g. repair activities);
- Lifting (and subsequent replacement) of EHU or installation of pipeline span supports;
- Vessel anchoring; and
- Preparing site for pipeline repair.

6.3.2 Known and Potential Environmental Impacts

The known and potential impacts of the above-mentioned hazards are:

- Localised turbidity of the near-seabed water column;
- Temporary disturbance to benthic habitats and fauna from this turbidity;
- Smothering cause by dropped objects or seabed disturbances;
- Permanent displacement of a small area of seabed habitat by subsea infrastructure; and
- Subsea infrastructure will act as artificial habitat for benthic fauna colonization.

The environment affected for seabed disturbance, given the intermittent and small area of the disturbance for with maintenance activities is expected to be localised around the activity site (anywhere along the pipelines and around the wellheads) in Victorian state or Commonwealth waters.

Receptors that may occur within the affected environment, either as residents or migrants, are:

- Sponge-reef habitat (KP19.5);
- Benthic species and filter-feeding epifauna (e.g. sponges, macroalgae and other rocky hard substrate species such as bryozoans (water depths > 60 m));
- Pelagic and demersal species (plankton, finfish); and
- Pinnipeds.

6.3.3 Evaluation of Environmental Impacts

Operations:

The pipeline infrastructure, which is not buried, has the potential to act as a water obstruction causing minor and localised alterations to the hydrodynamic regime directly around infrastructure (localised scouring/erosion or deposition of sediment build-up against infrastructure) over time. Erosion/scouring is monitored by the regular inspections of the pipeline, and measures in place to reduce freespan of pipeline. Given the relatively small area of the pipeline, impacts to the seabed are highly localised and are expected to have a negligible consequence.

The subsea infrastructure also acts as artificial habitat for marine organisms. Given the small footprint of this pipeline, any colonisation from adjacent benthic species will be limited in extent and not significant at a local level.

Maintenance and Repair:

During maintenance activities, the seabed in the immediate vicinity of the CHN assets may be disturbed due to the lifting of the EHU for inspection, seabed placement of small structures associated with the ROV or diving works, placement of grout bags and concrete mattresses to assist with free-span of pipelines, air/water lifting of built up sediment and minor excavation of the seabed. Non-routine activities such as removal of seabed sedimentation beneath the pipeline to prepare for repair activities would also disturb the seabed on a localised basis.

This EP does not include installation of new significant infrastructure (e.g., pipeline or umbilical), rock dumping or trenching. Where maintenance cannot be completed subsea it may be necessary to recover items to surface and replace them with effectively like for like. An example of this activity would be repair to the umbilical termination assembly (UTA) where by the UTA and umbilical would be recovered to surface and upon completion of the maintenance activities, the UTA and associated umbilical would be returned to the same location as originally found.

Where temporary ‘wet parking’ of equipment (e.g., ROV basket or clump weight) is required, a benign seabed location will be chosen (typically a sandy flat location which is representative of the seabed in the majority of the asset area or an area which limits impacts to hard substrate benthic habitats in water depths > 60m). This equipment is light weight, left on the seabed temporarily, and does not leave a permanent foot print on the seabed (negligible consequence). Trained and competent ROV operators will ensure that equipment placement and any ROV activities are undertaken with a minimum level of disturbance to the seabed.

For repair activities on sandy substrate, an estimated 0.5m of seabed sediment beneath the affected length of pipeline would require removal though this would be minimised to enable repair activities to proceed. Repairs would be undertaken in ‘sections’ so as to not exceed the free-span anomaly criteria for the pipeline (typically 10’s m) as appropriate to the damage incurred. This would most likely be undertaken by low-pressure water-jetting and in accordance with a Permit-to-Work authority to control levels of seabed disturbance. For sections of the pipeline in sand habitats with sparse epi-faunal habitats, pipeline repair activity may cause temporary localised disturbance however recolonization by adjacent benthic fauna is expected to be rapid (negligible consequence). For the sponge-reef habitat located at KP19.5 and areas around the wellheads in deeper water (rocky/hard substrates), pipeline burial is not expected and removal of significant sediment is not anticipated.

In the unlikely event of pipeline repair at KP19.5 or in hard substrate environments (water depth >60m), a pre-campaign risk assessment will identify controls to prevent disturbance to the sponge reef and hard substrate habitats. Repair activities may require lifting of the pipeline to enable repair over this area. With such measures adopted, impacts to the sponge-reef or hard substrate habitat would be considered to be localised, short-term and recoverable (negligible consequence).

Pipeline repair activities may also include the cutting of pipe with a diamond cutter or rotary milling tool which creates a minor amount of metal fragments which will be dispersed locally near the pipeline cutting sites. This metal will corrode over time however by-products are inert, impacts very localised and not expected to interfere with benthic habitats including the sponge reef present along the alignment (negligible consequence).

All activities listed above may result in a localised increase in the turbidity of the water column, and subsequent deposition of suspended sediment on the seabed. In turn this could have a localised ecosystem disruption through reduction in benthic productivity. The benthic environment along the pipelines is primarily a sand and gravel seabed containing sparse epifaunal habitats common to Bass Strait, and sediment remobilization is constant in these high energy marine environments. The benthic fauna in these areas adapt to these conditions and on this basis any localised increase in turbidity is expected to be temporary and rapidly recoverable (negligible consequence).

The lifting of the EHU or other existing infrastructure will result in the loss of artificial habitat and may displace marine benthic invertebrates utilising the artificial habitat created by the infrastructure. It is expected that any benthic invertebrates colonising the equipment such as the EHU will be capable of re-settling elsewhere or remaining with the habitat when re-laid.

Pipeline Freespan Rectification:

Grout bag installation will involve pumping grout (cement and water) through a hose from the vessel to fill grout bags underwater. Minor leakage of grout may occur during filling of the bags and when the hose is flushed with seawater at the completion of operations, dispersing residual grout into the marine environment. The volume of grout involved is expected to be very low (generally < 50 L).

The release of grout may create a localised increase in the turbidity of the water column, and a localised alteration to sediment composition and/or smothering of the benthos. The level of turbidity is expected to be minimal given that the cement is designed to set rapidly in the marine environment, will not disperse widely and would not be expected to exceed natural levels in the area. Installation of grout bags is expected to be undertaken within a very short duration of time (less than 1 day) and rapid recovery/recolonization of any benthic biota disturbed by settling cement material is expected to occur from adjacent areas (URS, 2001).

The volume of grout that may be released to the marine environment is very low and the potential affects would be restricted to the immediate vicinity of the operation. The benthic habitats present along the pipeline, including the sponge reef (KP19.5) or hard substrate habitats are not expected to be impacted by these small release volumes, particularly with the rapid remobilisation of sediments which occurs in the region. Given the very small extent of effects and the non-toxic nature of the grout, the consequences to benthic communities are expected to be temporary, localised and recoverable (negligible consequence).

Vessel Anchoring:

While most vessels involved in maintenance activities will use dynamic positioning (DP) or station-keeping anchoring may be required by some vessels for specific activities, or in case of an emergency. Anchoring is expected to be restricted to the shallower waters along the pipeline where strong currents present a safety hazard for longer duration activities (e.g. diving).

Shallow habitats along the pipeline are located in the mid-water depth range and consist of predominantly sandy habitats with intermittent patch reefs dominated by the brown alga.

Anchoring activities (except for emergency anchoring) will be planned and undertaken in accordance with approved procedures after a new or existing ROV survey of the anchoring area confirms:

- Intermittent patch reef or hard substrate habitats are not present in the anchor deployment area; or
- If anchoring must occur in these habitats, areas of lower sensitivity (i.e. lower coverage of epifauna) are preferentially targeted and anchoring techniques implemented to reduce impacts to ALARP.

No vessel anchoring will be undertaken at the sponge reef habitat located at KP19.5.

Direct contact by vessel anchors and anchor wires/chains can damage seabed habitats. Given the predominantly sandy nature of the seabed and the controls adopted, no long-term or significant impacts are predicted to benthic habitats. Further, it is expected that any localised impacts from anchoring would rapidly recolonise and recover following disturbance. This temporary impact will be negligible on a regional scale and the consequences are therefore negligible.

For marine growth removal impact assessment refer to Section 6.6.

<u>Impacts to Matters of NES</u>:

Seabed disturbance will not have a 'significant' impact to any of the matters of NES applicable to this project.

<u>Impacts to other areas of Conservation Significance</u>:

There are no other areas of conservation significance within the environment affected for seabed disturbance. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

6.3.4 Environmental Impact and Control Measure Summary

Aspect:	IMR activities impacting on the seabed
Impact summary	Localised turbidity of the near-seabed water column, temporary disturbance to benthic habitats and fauna from turbidity, habitat smothering, permanent displacement of small areas of seabed and infrastructure acting as an artificial substrate for benthic fauna colonisation.
Extent of impact	Localised (to area of maintenance activities), generally immediately adjacent to wellheads or pipeline.
Duration of impact	Temporary (minutes to weeks – rapid recovery of benthic sediments and fauna).
Level of certainty of impact	HIGH. Observed changes to seabed characteristics due to the placement of infrastructure have been observed during the life of the development. Seabed habitats are not sensitive in the region of the CHN development.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement.*

Control measures to be implemented to ensure any IMR activities consider seasonal sensitivities and restrict the seabed disturbance to the immediate area around the CHN assets include:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts, and identify environmental controls to be incorporated into offshore work procedures to restrict seabed disturbance around CHN assets;

- *IMR activity (controls):* Offshore activities undertaken in accordance with a Permit-to-Work and utilise approved work procedures;
- *IMR activity (frequency):* The pipeline will be regularly inspected in accordance with the IMP to identify and rectify areas of potential erosion/scouring;
- *Chemical selection*: Grouting activities only utilise chemicals which have an OCNS classification of non-CHARM D/E or CHARM gold/silver in accordance with the Cooper chemical selection requirements;
- *Contractor selection*: Contracted vessels shall have DP or vessel station-keeping capability;
- *Anchoring*:
  - Anchoring is permitted only when DP or station-keeping is not practicable or in the case of an emergency. Not practicable refers to longer duration activities located in areas where safety hazards can be mitigated through anchoring (e.g. shallower sections of pipeline);
  - Anchoring will be a planned activity in accordance with approved procedures after ROV survey review of area confirm that:
    - Intermittent patch reef or hard substrate habitats are not present in the anchor deployment area; or
    - If anchoring must occur in these habitats, areas of lower sensitivity are preferentially targeted and anchoring techniques to reduce impacts to ALARP are implemented;
    - No vessel anchoring will be undertaken at the sponge reef habitat located at KP19.5.
- *ROV contractor competency*: ROV will be controlled by a qualified and competent operator in accordance with approved procedures at all times.

6.4 Impact: Discharge of Gas

6.4.1 Hazard

The following maintenance activity has the potential to cause the release of gas:

- Replacement of wellhead chokes.

6.4.2 Known and Potential Environmental Impacts

The main concern regarding a gas (methane) release is the possibility that the action of methane-consuming microbes (methanotrophic bacteria) could exhaust oxygen in the water column.

It is important to note that choke replacement is highly unlikely to result in condensate release. It is expected to result in 0.55 m^3 (at tubing head pressure, or 42 m^3 at atmospheric pressure) of gas only.

The known and potential impacts of a gas condensate release (from an unplanned pipeline leak, rupture or wellhead release) are assessed in detail in Section 6.21.

The environment affected by a gas release from wellhead chokes is likely to be within a 50 m radius of the wellhead (across all depths of the water column). Note this impact is only expected in Commonwealth waters.

APASA (2013) modelled a methane/natural gas release from the Henry gas field in the Otway Basin of Bass Strait in a water depth of 55 m. This modelling found that the gas plume (as a result of a pipeline rupture) rose to the sea surface in less than 10 seconds and that the gas plume could surface anywhere within a 50 m radius of the release site. At the release site, the sea would appear to bubble.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic species (plankton, fin fish);
- Cetaceans; and
- Pinnipeds.

6.4.3 Evaluation of Environmental Impacts

Gas released at the seabed will rapidly dissipate through the water column and cause only temporary water quality reduction and little to no impact to marine fauna.

Research undertaken for the Macondo oil blowout in the Gulf of Mexico in 2010 indicates that there is a large gap in the data for impacts of methane released to the ocean. The following information is sourced from ‘BP Oil Spill - Crisis in the Gulf’ (Anonymous, 2010).

> *Low-oxygen conditions that may be created by the gas release could threaten small marine organisms – plankton, fish larvae, and other creatures that can't roam large distances, but form a vital link in the marine food chain.*

A research trip in the Gulf of Mexico took measurements over a distance that ranged from about 480 m from the Macondo blowout location to 13 km away. The team found that dissolved methane concentrations were low in the surface water, very high at depths greater than 1,000 m and somewhat elevated in between. The researchers interpret this to mean that the vast majority of the methane that escapes is trapped at depths of around 1 km and that only small amounts are likely to escape through the ocean to the atmosphere. The methane remains in the deep water because in temperate and tropical oceans, seawater forms stable layers that don't readily mix upward.

Analysis of the dissolved gas content from another 90 locations (at various depths for each location) within a 48 km x 64 km radius around the Macondo blowout location revealed a layer within 8 km of the blowout in which the dissolved methane was six times higher than the dissolved oxygen.

In this area, methanotrophic bacteria could use up all of the oxygen in that ‘lens’ of seawater, dropping oxygen levels to zero. However, the breakdown of methane occurs very slowly and degradation microbes are also aerobic. At some point their activity could slow or stop before all of the oxygen in a methane-heavy parcel of water disappeared. As a consequence microbial breakdown of the methane could reduce oxygen concentrations to levels untenable for a range of marine creatures, and just as a lack of vertical mixing in the deep water is holding the dissolved methane at depth, that lack of mixing keeps high levels of dissolved oxygen at the surface from replenishing oxygen levels in the deep water. Unlike the Macondo well, the CHN assets are located in shallow waters (ranging in depth from 10 m to 65 m).

The rapid rise of the gas to the surface indicates that most of the gas (including the portion that is methane) will be released to the atmosphere rather than trapped at depth in the water column. A small portion may remain in the waters occupied by and surrounding the gas plume, but this would not be expected to result in significant oxygen depletion due to the fact that Bass Strait waters are generally well mixed.

At the water depths of the CHN assets, thermal stratification is not normally expected (some weak thermal stratification may occur in calm summer conditions, but generally only in the middle of Bass Strait). Thus, the ‘trapping’ of methane in deep cold waters is unlikely to occur, meaning that oxygen depletion (and consequent mass kills of marine life) in any one layer of the water column is unlikely to occur.

A release of gas at the Elgin Platform operated by Total offshore from the United Kingdom did not have any reportable impacts on marine fauna from the release of 175 tonnes of gas per day (Government Interest Group (UK), 2012). Given the significantly smaller volume that may be released during wellhead choke replacement at the CHN assets, the consequence of its release is considered to be negligible.

Impacts to Matters of NES:

A gas release from wellhead chokes will not have a 'significant' impact to any of the MNES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by a gas release from the wellheads. The Shelf Rocky Reef and Hard Substrate KEF may lie adjacent to wellheads but is not expected to be affected.

6.4.4 Environmental Impact and Control Measure Summary

Aspect:	Maintenance Activity releasing gas
Impact summary	Reduction in water quality within the water column.
Extent of impact	Localised (to area around wellhead).
Duration of impact	Temporary (minutes) – rapid dispersion and dilution.
Level of certainty of impact	HIGH. Choke replacement activities have been undertaken on CHN successfully.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement.*

Control measures to be implemented to ensure any IMR activities consider and reduce impacts to seasonal sensitivities, prevent the need for choke replacement and gas releases during any choke replacement activities which are required include:

- *Scale inhibitor injection*: Scale inhibitor is utilised as part to the corrosion management to prevent scaling of choke and the need for replacement;
- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity, and identify environmental controls to be incorporated into offshore work procedures to prevent gas releases from CHN assets during maintenance activities;
- *IMR activity (controls):* Offshore activities undertaken in accordance with a Permit-to-Work and utilise approved work procedures;
- *Volume release mitigation (choke replacement):* Control implemented to limit the amount of gas released during choke replacement includes:
    - o Gas displacement from the jumper line with MEG prior to choke removal;
    - o Coke is isolated from pressure-bearing systems by a double-block and bleed valve;
- *Emergency response:* Cooper emergency response procedures are implemented in the event of an uncontrolled release of gas from the wellhead.

6.5 Impact: Discharge of Production Chemicals

6.5.1 Hazard

The following maintenance activities have the potential to result in production chemicals being discharged to the ocean:

- Wellhead Choke replacement resulting in a small (1 m^3) release of low-toxicity MEG and scale inhibitor chemical.

6.5.2 Known and Potential Environmental Impacts

The known impact of the release of MEG is a temporary and localised reduction in water quality.

Given the small discrete amount of fluid released at approximately 2-3 m above sea level, and its rapid dilution in localised currents, the environment affected by the discharge of chemicals is expected to be localised around the wellhead during wellhead choke replacement (conservatively across all depths of the water column). This will only affect Commonwealth waters.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Filter-feeding epifauna (e.g. sponges, macro-algae and rocky hard substrate species such as bryozoans (water depths > 60m));
- Benthic species;
- Pelagic and demersal species (plankton, fin fish);
- Cetaceans; and
- Pinnipeds.

6.5.3 Evaluation of Environmental Impacts

MEG (90% MEG, 10% water) has low toxicity and is readily biodegradable, and is rated as posing little or No Risk (PLONOR) to the environment by OSPAR. The current scale inhibitor used is an OCNS rated 'D' non-CHARM chemical. Releases of this type are very infrequent.

For the maximum identified release volumes of MEG (1000 litres), screening calculations identify concentrations above the Predicted No Effects Level (PNEC) of 859 mg/l (WHO, 2000) may be present within 18.7 m of the wellhead (localised) for approximately 1100 seconds during a planned discharge event. This low volume, low-toxicity and short duration release is expected to have negligible consequences to receptors.

Impacts to Matters of NES:

The discharge of chemicals will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the EMBA for a chemical release from the assets. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

6.5.4 Environmental Impact and Control Measure Summary

Aspect:	Release of Production Chemicals
Impact summary	Reduction in water quality within the water column.
Extent of impact	Localised (to area around wellhead and PLEM).
Duration of impact	Temporary (minutes [wellhead choke replacement]) – rapid dispersion and dilution.
Level of certainty of impact	HIGH. Activity has been completed before on the CHN wellheads. Activity and discharges are well understood.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to ensure any IMR activities consider and reduce impacts to seasonal sensitivities and ensure that impacts from chemical discharges during IMR activities are reduced to levels which area as low as practicable include:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity, and identify environmental controls to be incorporated into offshore work procedures to prevent chemical releases from CHN assets during maintenance activities;
- *IMR activity (controls):* Offshore activities undertaken in accordance with a Permit-to-Work and utilise approved work procedures;
- *Chemical selection:* Production chemicals selected are low toxicity and meet Cooper's chemical selection requirements.

6.6 Impact: Removal of marine growth from subsea infrastructure

6.6.1 Hazard

The following activities will result in the removal of marine growth attached to subsea infrastructure:

- High-pressure water jetting;
- Brushing with plastics and/or wire brushes;
- Scraping with rotary polymer scrapers (Flexiclean or equivalent); and
- Grit-blasting.

As part of ongoing maintenance and to facilitate inspections, or enable pipeline repairs, the removal of marine growth from infrastructure using inspection or work-class ROVs and/or divers may be required. Marine growth may be removed with high-pressure water jetting, brushing or scraping or a combination of these. Only sections of infrastructure with encrusting organisms that make maintenance activities difficult (e.g., access to subsea tree valves), need to be repaired (e.g. clamp/wrap installation) or require inspection using specialised equipment (e.g. Combi-Crawler) would be considered for marine growth removal. This is expected to occur infrequently for inspection and maintenance activities (once every few years at most) and rarely for pipeline repair.

6.6.2 Known and Potential Environmental Impacts

The known impacts of this activity are:

- A temporary and localised reduction in water quality (i.e., increased turbidity due to sand or marine growth debris discharge);
- The dislodgment (and possible death) of marine growth (macro-algae and epi-fauna such as sponges, ascidians and molluscs) attached to the subsea infrastructure; and
- Settling of sand used for blasting on the seabed.

Given the small areas which may be targeted for marine growth removal, impacts are expected to be extremely localised around the cleaning location and recoverable. This impact may occur in Victorian state or Commonwealth waters.

Receptors that may occur within the environment affected, either as residents or migrants, are:

- Benthic species (especially those encrusting organisms being removed);
- Filter-feeding epifauna (e.g. sponges, macroalgae and rocky hard substrate species such as bryozoans (water depths > 60 m));
- Sponge reef habitat (KP19.5); and
- Pelagic and demersal species (plankton, fin fish).

6.6.3 Evaluation of Environmental Impacts

Temporary and localised reduction in water quality:

Sand or water blasting will cause localised and temporary turbidity due to disturbance of surrounding sediments and the dislodgment of marine growth. This is unlikely to affect benthic productivity around the CHN assets due to the short lengths and periods over which marine growth removal will be conducted at any location. Given the majority of the pipeline alignment is located in sandy seabed environments with sparse epifauna, disturbance to benthic habitats are expected to be temporary and localised to the immediate vicinity of the infrastructure. Similarly at the sponge reef habitat (KP19.5), the temporary water quality reduction is not expected to be significant to the productivity of the reef (negligible impact). Additionally, water column quality will return to pre-activity levels rapidly due to strong ocean bottom currents and the natural effects of dilution. The consequences of this impact are considered negligible.

Dislodgment of marine growth:

The dislodgement and/or death of biota caused by blasting will have, at worst, a short-term impact on biodiversity and productivity around the assets. The biota that originally colonised the infrastructure is representative of fauna from nearby stable substrates (e.g., rocky reef) and it is likely these habitats will again form the 'sink' for species recolonising infrastructure that has had marine growth removed. The consequences of this impact are considered negligible.

Additional sand settlement on seabed:

Water blasting will be given preference to grit blasting of sub-sea infrastructure.

The use of sand (beach sand, and not for example garnet) will not have long-term impacts given that the seabed around the asset is predominantly sand. No chemicals will be added to the sand. Discharged sand will settle on the seabed and become congruous with its surrounds. Any small flakes or particles of coatings that may be dislodged from the infrastructure due to blasting which settle on the seabed are not expected to form a physical impediment to biota settling on or in the seabed sediments. For sand substrates and rocky hard substrate habitats with sparse epifauna given the dynamic nature of the seabed environment and limited area affected, the impact is considered negligible.

Sand blasting at more sensitive habitats such as the sponge reef (KP19.5) may have greater impacts. Sponges are an important component of benthic ecosystems worldwide and as sessile suspension feeders, may be impacted by changes in sediment levels. Bell et al (2015) in a review of the current literature on sediment impacts to sponges identified that sediment may have the following impacts:

- Direct ingestion of fine particles can block or clog filtering apparatus and impact on physiological processes (i.e. reduce feeding);
- Larger sediment particles can scour external surfaces;
- Increasing sedimentation creates turbidity and reduces light penetration which will affect phototrophic species; and
- Larvae may be prevented from settling if suitable collection substrates are covered by sediment.

Bell et al, (2015) also identify that sponges can adapt to tolerate high levels of sedimentation and many species are commonly found in environments experiencing high levels of suspended and settled sediment. Sedimentation is identified as a threat to the Bass Strait sponge beds located approximately 70 km to the east of the CHN Development (Butler et al, 2002).

It should be noted that sponge species present along the CHN pipeline alignment have adapted to a high energy, high sediment resuspension environment. This has been observed in drilling activities in the Otway marine environment where rapid sediment resuspension and transport has been observed (Currie & Issacs, 2005).

A pre-campaign risk assessment will assess potential environmental impacts and risks from IMR activities and identify environmental controls. A possible control adopted for these areas is to utilise techniques such as water jetting, brushing or scraping in these more sensitive areas to reduce impacts. With such techniques adopted predicted impacts to sponges is expected to be localised and recoverable (negligible consequence).

<u>Impacts to Matters of NES</u>:

The removal of marine growth will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

<u>Impacts to other areas of Conservation Significance</u>:

There are no other areas of conservation significance within the environment affected by marine growth removal from the assets. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

6.6.4 Environmental Impact and Control Measure Summary

Activity:	Removal of Marine Growth
Impact summary	Reduction in water quality. Loss of encrusting marine biota.
Extent of impact	Localised (to area being cleaned).
Duration of impact	Water quality – temporary (due to rapid dispersion and dilution). Loss of biota – short-term. Biota will recolonise infrastructure rapidly (ongoing).
Level of certainty of impact	HIGH. Activity is localised with only local species affected. Recovery will be rapid based upon observed marine growth over the lifetime of the asset.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to ensure any IMR activities consider and reduce impacts to seasonal sensitivities and ensure that impacts from marine growth removal during IMR activities are reduced to levels which are as low as practicable include:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity, and identify environmental controls to be incorporated into offshore work procedures to restrict seabed disturbance and biota loss from marine growth removal from CHN assets during maintenance activities;
- *IMR activity (controls):* Offshore activities undertaken in accordance with a Permit-to-Work and utilise approved work procedures;
- *Activity constraints:* The following constraints will be adopted during activities:
  - Only areas subject to maintenance are cleaned;
  - For sensitive environments such as sponge reefs, lower impact removal methods are adopted (e.g. water jetting, scraping or brushing); and
  - Only beach sand is used for grit blasting.

6.7 Impact: Underwater sound disturbance (Vessel and Helicopter)

6.7.1 Hazard

The following vessel activities have the potential to create underwater sound that may disturb marine fauna:

- Engine noise transmitted through the vessel hull; and
- Propeller/thruster noise;
- Use of side-scan sonar; and
- ROV.

Vessels

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

Vessels engaged for maintenance activities will generally 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 range (Gotz *et al.*, 2009). In comparison, underwater sound levels generated by large ships can produce levels exceeding 190 dB re 1µPa (Gotz *et al.*, 2009) and vessels up to 20 m size class typically 151-156dB re 1µPa (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 will have a smaller sound footprint given the smaller size vessel.

Helicopters:

Helicopters are only likely to be used in a medical evacuation situation, and are not planned to be used for personnel transfers during IMR activities.

The main acoustic source is the impulsive noise from the main rotor, which consists of blade-vortex interaction noise in descent or level flight at low and medium velocities and high-speed impulsive noise related to trans-sonic effects on the advancing blade. The rotating blades of helicopters produce tones with fundamental frequencies proportional to the rotation rate and number of blades. Dominant tones in noise spectra from helicopters and fixed wing aircraft are generally below 500 Hz (Richardson *et al*., 1995). Other tones associated with the main and tail rotors and other engine noise can result in a larger number of tones at various frequencies. Information on reactions of whales to aircraft is mostly anecdotal. Reactions of baleen whales to circling aircraft (fixed wing or helicopter) are sometimes conspicuous if the aircraft is below an altitude of 300 m, uncommon at 460 m and generally undetectable at 600 m (Richardson *et al*., 1995; NMFS, 2001).

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson *et al*., 1995). Sound generated 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 four minutes before the helicopter passed over underwater hydrophones. The helicopter was audible underwater for only 38 seconds at 3 m depth and 11 seconds 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.

Side scan sonars operate at high frequencies typically between 100 to 500 kHz. These devices operate at frequencies similar to those used in ‘fish finders’ by commercial fishermen. Higher frequency emissions utilised in these operations dissipate to safe levels over a relatively short distances as the sound is rapidly absorbed by the surrounding water column (DEHLG, 2007).

6.7.2 Known and Potential Environmental Impacts

The primary concern arising from underwater sound generation is the potential non-physiological effects on 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.

The environment affected from underwater sound generated by vessels is likely to be within a radius of a few hundred metres of the vessel, dependent on the exact size of the vessel, water depth and seabed type.

The environment affected from underwater sound generated by helicopters is expected to be localised at surface.

Sound impacts may occur in both Victorian state and Commonwealth waters.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic species (plankton, fin fish);
- Cetaceans; and
- Pinnipeds.

6.7.3 Evaluation of Environmental Impacts

Vessel sound:

Increased levels of underwater noise generated by vessels supporting ROV/diving activities, particularly from vessel (DP) thrusters, have the potential to disturb noise sensitive marine fauna.

Activities that generate underwater noise can affect marine fauna by interfering with aural communication, eliciting changes in behaviour or, in extreme cases, by causing physiological damage to auditory organs. The potential for noise from anthropogenic sources to impact fauna depends on a range of factors, including the intensity and frequencies of the noise, prevailing ambient noise levels and the proximity of noise sensitive species.

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. However, the amount of evidence is slender and it is not known whether these animals are affected or are stressed by these encounters (Peterson and Bartholomew, 1967; cited in Richardson et al, 1995).
- Dolphins of many species tolerate or even approach vessels but sometimes members of the same species 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 showed subtle tendencies to swim faster especially if more than one boat was nearby and tend 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 patters and more erratic surface movements. Near those boats, surface times tended to be reduced with fewer blows per surfacing, shorter intervals between successive blows and increasing frequency of dives without raised flukes (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 in the species particularly when the vessels are moving fast and erratically, however there is little response to slow-moving or 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 idleing 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.). Overall humpbacks tended to avoid vessels and sometimes directed threats toward them. 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 appear 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).

Sound sensitive species will be present in the CHN area during IMR activities. While sound levels generated by the IMR vessel are not expected to be sufficient to damage fauna, it is considered that localised and short-term displacement of sound sensitive species around the IMR vessel may occur. It is noted the Victorian State waters section of the CHN pipeline (VIC/PL37(v)) alignment is a BIA for migrating and resting southern right whales. Avoidance effects demonstrated by these species will be localised, short-term and not significant at a population level (minor consequence).

Vessel sound on benthic fauna (e.g. lobsters and sponges) will be similar to fishing vessels present in the area and given the low levels of sound emitted, not expected to have any physiological or behavioural impacts on these species.

Aviation sound:

Increased underwater and airborne noise from helicopter movements has the potential to cause behavioural impacts to birds along flight paths and behavioural changes in cetaceans. Airborne noise from helicopters generally only penetrates water at angles greater than 26° (Richardson et al., 1995). Generally this only results in a temporary change in behaviour (e.g., diving, tail slaps) in whales, which return to normal behaviour once the helicopter has passed (Richardson et al., 1985; Richardson and Malme, 1993), and occasional overflights are thought to have no long term impact on cetaceans (NMFS, 2001).

The majority of activity will be located offshore and therefore avoid sensitive nearshore areas (e.g., shorebird resting and breeding sites). With the very low level of helicopter movement expected to be required, significant disruption to seabirds or cetaceans from helicopter sound is very low (negligible consequence).

Impacts to Matters of NES:

Underwater sound from vessels, helicopters and ROV operations will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by underwater sound. This discharge will not have any impacts to other areas of conservation significance.

6.7.4 Environmental Impact and Control Measure Summary

Aspect:	Vessel and Aviation Sound Disturbance
Impact summary	Behavioural changes (e.g., startle response) in sound-sensitive species, especially cetaceans.
Extent of impact	Localised.
Duration of impact	Temporary (duration of vessel, helicopter or ROV presence).
Level of certainty of impact	HIGH. Significant research has been undertaken on the impacts of underwater sound on biological receptors.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to ensure any IMR activities consider and reduce impacts to seasonal sensitivities and reduce behavioural impacts to sound sensitive species include:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Vessel Maintenance:* Vessel engine and propulsion systems are maintained in accordance with the vessel's planned maintenance system to ensure efficient operation of equipment and minimising excessive noise;
- *Vessel/cetacean caution zones*: Vessels will adhere to proximity distances and vessel management practices for sound sensitive species as detailed in the Commonwealth Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8) and Victorian Wildlife (Marine Mammals) Regulations 2009:
  - Vessels will travel at less than 5 knots within the caution zone of a cetacean and minimise noise (Caution Zone is 150m radius for dolphins, 300 m for whales and 50m for pinnipeds);
  - The vessel must not drift closer than 50 m (dolphin and pinniped) 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;
  - The vessel must not restrict the path of a marine mammal;
  - The vessel must not separate any individual from a group of marine mammals or come between a mother whale and calf or a seal and pup;

  - If the vessel is within the caution zone of a marine mammal the vessel must move at a constant speed that does not exceed 5 knots, avoids sudden changes in speed or direction and manoeuvres the vessel to outside the caution zone if the marine mammal shows any sign of disturbance;
  - If a vessel is within the caution zone of a marine mammal, the vessel shall not approach a marine mammal from head on, from the rear or be in the path ahead of a marine mammal at an angle closer than 30º to its observed direction of travel.
- *Helicopter Sound:* Helicopters will ensure buffer distances of 500 m (are maintained around cetaceans in accordance with EPBC Regulations 2000 (Part 8)).

6.8 Impact: Atmospheric Emissions (Vessels)

6.8.1 Hazard

The use of fuel (specifically marine-grade diesel) to power engines, generators and mobile and fixed plant (e.g., ROV, crane), 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 Environmental Impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to particulate matter from diesel combustion; and
- Contribution to the global GHG effect.

The environment affected by atmospheric emissions from vessel activities is the local air shed – with rapid dispersion around the discharge point due to the local wind regime.

Emissions may be within Victorian state or Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Seabirds.

6.8.3 Evaluation of Environmental Impacts

Localised and temporary decrease in air quality from diesel combustion:

The combustion of diesel fuel can create continuous or discontinuous plumes of particulate matter (soot or black smoke) and the emission of non-GHG, such as NO_X and SO_X. Inhaling this particulate matter can cause or exacerbate health impacts to humans exposed to the particulate matter, such as offshore project personnel or residents of nearby towns (e.g., respiratory illnesses such as asthma) depending on the amount of particles inhaled. Similarly, the inhalation of particulate matter may affect the respiratory systems of fauna. Along the CHN assets, this is limited to seabirds overflying the vessel/s.

Particulate matter released from the vessel/s is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Port Campbell and Peterborough), as offshore winds will rapidly disperse and dilute particulate matter. This rapid dispersion and dilution will also ensure that seabirds are not exposed to concentrated plumes of particulate matter from vessel exhaust points.

Contribution to the GHG effect:

While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are relatively small on a global scale, and temporary, representing an insignificant contribution to overall GHG emissions. The IMR vessel would typically consume 0.3m^3 of fuel per day[2] which is 0.000000155% of the National Greenhouse Gas inventory for 2014 (DoEE, 2017a).

Impacts to Matters of NES:

Atmospheric emissions from vessels undertaking maintenance inspections or activities will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the atmospheric emissions environment affected. This discharge will not have any impacts to other areas of conservation significance.

6.8.4 Environmental Impact and Control Measure Summary

Aspect:	Air Emissions (Vessel)
Impact summary	Air pollution and contribution to the GHG effect.
Extent of impact	Localised (local air shed).
Duration of impact	Short-term (emissions rapidly dispersed and diluted).
Level of certainty of impact	HIGH. The impacts of atmospheric impacts from air emissions are well studied and regulated.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

Control measures to be implemented to control equipment air emissions in accordance with MARPOL requirements with no third party complaints are:

- *Air Emissions Equipment*: Vessels with diesel engines > 130 kW must be certified to emission standards (e.g. IAPP, IEAPP);
- *Fuel Quality*: Vessels utilize 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 SEEMP to monitor and reduce air emissions;
- *Equipment Maintenance:* Vessel equipment which emits combustion products (e.g. engines) are maintained in accordance with vessel planned maintenance system to ensure performance;
- *Fuel Monitoring*: Fuel consumption is monitored on IMR vessels (and portable back-deck equipment) and abnormally high consumption investigated ;
- *Back-deck Equipment:* Portable back-deck equipment is inspected and found to be in good 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 incident management process.

Control measures to be implemented to control incineration emissions, if the vessel has an incinerator, to regulated standards are:

[2] Basis is vessel Bass Trek utilised in recent Cooper BMG IMR activities.

- The incinerator is IMO-certified;
- Personnel responsible for the operation of the incinerator are trained;
- The minimum flue temperature is maintained at 850^{o}C).

6.9 Impact: Light Emissions (Vessel Activities)

6.9.1 Hazard

Light emissions will occur for the duration of any vessel-related activities, such as:

- Vessel operations – navigational and vessel deck lighting, kept on 24 hours a day for maritime safety and crew safety purposes; and
- ROV operations – underwater light when submerged to illuminate an area of interest (e.g., the pipeline).

During the activity, the vessel/s 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.

6.9.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of artificial lighting offshore are:

- Localised light glow that may act as an attractant to light-sensitive species (e.g., seabirds, squid, turtle hatchlings), in turn affecting predator-prey dynamics; and
- Attraction of light-sensitive species during breeding periods (e.g., turtle hatchlings).

The environment affected by light emissions from vessel activities will be localised based upon the limited low-intensity light sources on-board the vessel.

This hazard may affect Victorian state or Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

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

6.9.3 Evaluation of Environmental Impacts

Localised light glow that may act as an attractant to light-sensitive species:

Seabirds may be attracted to vessels at night due to the light glow. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with infrastructure, or mortality from starvation due to disrupted foraging at sea (Wiese et al., 2001).

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie et al., 2008) and that lighting can attract birds from large catchment areas (Wiese et al., 2001). The light may provide enhanced capability for seabirds to forage at night. There are no actions within the National Recovery Plan for Threatened Albatrosses and

Giant Petrels 2011-16 (SEWPC, 2011) that are compromised by light emissions from this project.

Fish and zooplankton may be directly or indirectly attracted to lights. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al., 2000), with traps drawing catches from up to 90 m (Milicich et al., 1992). Lindquist et al (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al. (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

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 (WDCS, 2004), so light is not considered to be a significant factor in cetacean behaviour or survival.

Underwater light from using an ROV is unlikely to cause 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 usually for a few minutes at a time near the seabed where the ROV conducts most of its work. Observations of ROV inspections at the seabed (Pinzone, pers. obs., 2013) indicate that fauna is not negatively impacted by the bright light source, and other than some fauna exhibiting inquisitiveness, fish and other fauna continue to behave normally.

Attraction of light sensitive species during breeding periods:

Light pollution along, or adjacent to, turtle nesting beaches poses a particular issue for turtles because it alters critical nocturnal behaviours, particularly the selection of nesting sites and the passage of adult females and emerging hatchlings from the beach to the sea (CoA, 2017). There are no turtle rookeries along the Otway coast, so lighting will not impact turtle hatchlings.

Impacts to Matters of NES:

Light emissions will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by light emissions. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

6.9.4 Environmental Impact and Control Measure Summary

Aspect:	Vessel Lighting
Impact summary	Localised light glow that may act as an attractant to light-sensitive species (e.g., birds, squid).
Extent of impact	Localised (small radius of light glow around vessel).
Duration of impact	Temporary (short duration of vessel activity).
Level of certainty of impact	HIGH. The impacts of light on light-sensitive species are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). *ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement*

The control measure to be implemented to control lighting to a minimum which still allows for safe operation is:

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

6.10 Impact: Treated Sewage and Grey Water Discharges (Vessels)

6.10.1 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 is likely to result in the discharge of several hundred litres of treated sewage and greywater each day.

6.10.2 Known and Potential Environmental Impacts

The known and potential environmental impact of treated sewage and grey water discharges is:

- Temporary and localised reduction in surface water quality (i.e., increase in the nutrient content) around the vessel/s.

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

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

This emission may occur in Victorian state or Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Plankton;
- Pelagic fish; and
- Seabirds.

6.10.3 Evaluation of Environmental Impacts

Sewage discharges will meet the requirements of MARPOL Annex IV. Vessels usually treat sewage/grey water through a sewage treatment plant (STP) to a tertiary level; or if not treated, comminute, disinfect and discharge from the vessel while en-route at distances greater than 4 nm from shore; or discharge from the vessel while en-route at distances greater than 12 nm from shore.

Nutrients in sewage, such as phosphorus and nitrogen, may contribute to eutrophication of receiving waters (although usually only still, calm, inland waters and not offshore waters), causing algal blooms, which can degrade aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans. Pathogens are also an issue if ingested (not an issue with STP or comminution and disinfection treatment options).

Grey water (used water from the galley, dishwashers, showers, hand basins and laundry) can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, food waste, coliform bacteria and some medical waste. Grey water is also treated through the STP, so pollutants would be largely removed from the discharge stream.

The effects of treated 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. Monitoring at stations 50, 100 and 200 m downstream from the rig and at five different water depths confirmed that the discharges were rapidly diluted in the upper 10 m water layer with no elevations in water quality monitoring parameters (e.g., total nitrogen, total phosphorous and selected metals) recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the high numbers of personnel on-board a drill rig compared with vessels undertaking IMR activities, and the environment much less dispersive than vessels that are in constant movement 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 low volumes of the discharges, the treatment of the discharge, the high dilution and dispersal factor, and short discharge period, the risk of treated sewage and grey water discharged from vessels having an adverse effect on marine life is very low (negligible consequence).

Impacts to Matters of NES:

The discharge of treated sewage and grey water will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by sewage and grey water discharges. This discharge will not have any impacts to other areas of conservation significance.

6.10.4 Environmental Impact and Control Measure Summary

Aspect:	Vessel Sewage Discharge
Impact summary	Increase in nutrient content of surface waters, which may modify feeding habits of pelagic fish and seabirds.
Extent of impact	Localised (about 10 m vertically and 50 m horizontally).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of sewage and grey water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 requirements are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *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 is 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 is discharged 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 is discharged 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 ensure system performance.

6.11 Impact: Cooling Water and Brine Discharges (Vessels)

6.11.1 Hazard

Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Brine is created through the vessels desalination processes for potable water generation.

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

The maximum cooling water discharge rate for the vessels that may be used during inspection and maintenance activities is unknown. Also unknown is the temperature at which the heat exchangers are designed to discharge the cooling water at (generally several degrees Celsius above ambient sea temperature).

Brine water (hypersaline water) is created through the desalination process that creates freshwater for drinking, showers, cooking etc. This is achieved through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). The freshwater produced is then stored in tanks on board. Upon discharge, the concentration of the brine, based on other modern vessels, is likely to range from 44-61 ppt, which is 9-26 ppt higher than seawater salt concentration (35 ppt). Brine concentration is dependent on throughput and plant efficiency, with brine concentrations unable to be determined until sea trials.

6.11.2 Known and Potential Environmental 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;
- Temporary and localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna.

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

This discharge may occur in both Victorian state or Commonwealth areas.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

6.11.3 Evaluation of Environmental Impacts

Temporary and localised increase in sea water temperature:

Once in the water column, cooling water will remain in the surface layer, where turbulent mixing and heat transfer with surrounding waters will occur. Prior to reaching background temperatures, the impact of increased seawater temperatures down current of the discharge may result in changes to the physiological processes of marine organisms, such as attraction or avoidance behaviour, stress or potential mortality.

Modelling of continuous waste water discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008).

Temporary and localised increase in sea surface salinity:

Brine water will sink through the water column where it will be rapidly mixed with receiving waters, and disbursed by ocean currents. Walker and MacComb (1990) found that most marine species are able to tolerate short-term fluctuations in water salinity in the order of 20-30%, and it is expected that most pelagic species passing through a denser saline plume would not suffer adverse impacts. Other than plankton, pelagic species are mobile and would be subject to slightly elevated salinity levels for a very short time as they swim through the 'plume.'

Potential toxicity impacts:

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

These chemicals are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process, ensuring there is little or no residual chemical concentration remaining upon discharge.

Impacts to Matters of NES:

The discharge of cooling water and brine will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the affected environment by cooling water and brine discharges. This discharge will not have any impacts to other areas of conservation significance.

6.11.4 Environmental Impact and Control Measure Summary

Aspect:	Cooling water and Brine Discharge
Impact summary	Increase in temperature and salinity of surface waters.
Extent of impact	Localised (about 10 m vertically and 100 m horizontally).
Duration of impact	Temporary (rapid dispersion, dilution and cooling - minutes).
Level of certainty of impact	HIGH. The impacts of cooling water and brine discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and cooling and brine water discharges are within specified operating parameters are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Equipment Maintenance*: Vessel engines and associated equipment that require cooling by water will be maintained in accordance with the vessel's preventative maintenance system so they are operating within accepted manufacturer's parameters;
- *Contractor (Chemical) Selection:* As part of contractor selection chemicals utilized as biocides or scale inhibitors utilised in the cooling and brine water system will be low toxicity and meet Cooper chemical standards.

6.12 Impact: Putrescible Waste Discharge (Vessels)

6.12.1 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 would be in the order up to 10 kg/day.

6.12.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of putrescible waste discharge are:

- Temporary and localised increase in the nutrient content of surrounding surface waters; and
- Increase in scavenging behaviour of marine fauna and seabirds.

The environment affected by putrescible waste discharges from vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the discharge point.

This discharge will only occur in Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Plankton;
- Pelagic fish; and
- Seabirds.

6.12.3 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 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.

Impacts to Matters of NES:

The discharge of putrescible waste will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by putrescible waste discharges. This discharge will not have any impacts to other areas of conservation significance.

6.12.4 Environmental Impact and Control Measure Summary

Aspect:	Food-scrap discharges from vessel
Impact summary	Increase in nutrient content of surface waters, which may lead to scavenging behaviour of pelagic fish and seabirds.
Extent of impact	Localised around discharge point
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of putrescible waste discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and ensure that food-scrap discharges comply with Annex V requirements are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *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 and efficient operation;
- *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.

6.13 Impact: Bilge Water Discharges (Vessels)

6.13.1 Hazard

Bilge tanks receive fluids from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats prior to discharge overboard in order to meet the MARPOL requirement of no greater than 15 ppm oil-in-water (OIW) overboard.

6.13.2 Known and Potential Impacts

The known and potential environmental impacts of the discharge of bilge water discharges are:

- Temporary and localised reduction of surrounding surface water quality; and
- Acute toxicity to marine fauna through ingestion of contaminated water (in the event of malfunction of the OWS).

The environment affected by treated bilge discharges from vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the release point.

This discharge may occur in Victorian state or Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

6.13.3 Evaluation of Environmental Impact

Temporary and localised reduction of surface water quality:

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges may temporarily reduce water quality. The bilge water will be rapidly diluted, dispersed and biodegraded to undetectable levels.

Acute toxicity to marine fauna:

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

Impacts to Matters of NES:

The discharge of bilge water will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the EMBA by bilge water discharges. This discharge will not have any impacts to other areas of conservation significance.

6.13.4 Environmental Impact and Control Measure Summary

Aspect;	Treated Bilge Water Discharge (Vessel)
Impact summary	Pollution of surface waters. Acute toxicity to marine fauna exposed to pollution.
Extent of impact	Localised (about discharge point).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of oily water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and ensure that bilge discharges comply with MARPOL Annex I requirements are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Oil Water Separation Equipment:* For vessels > 400 tonnes, bilge water is treated in a MARPOL-approved OWS;
- Treated Bilge Discharge Quality:
  - For vessels > 400 tonnes, treated bilge water discharge occurs if:
    - Treatment is via a MARPOL–compliant OWS;
    - The OIW content is less than 15 ppm; and
    - Oil detection monitoring and control equipment are operating.
  - For vessels < 400 tonnes, treated bilge is discharged if:
    - Vessel is proceeding en-route;
    - Approved treatment equipment ensures oil content is less than 15ppm.

  If the above cannot be met 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 that reliable discharge concentrations are being met;

- *Residual Oils*: Residual whole oils from the OWS are disposed onshore.

6.14 Risk: Discharge of Contaminated Deck Drainage (Vessels)

6.14.1 Hazard

The following activities may result in the discharge of contaminated deck drainage water to the ocean:

- Deck washing, ocean spray, 'green' water and rain that capture minor contaminants such as oil, grease and detergents on the deck prior to draining overboard; and
- A chemical, oil or grease spill or leak on deck that is washed overboard.

Generally, all deck drains in non-hazardous areas drain directly overboard (and are not routed to the bilge water tank for treatment).

6.14.2 Known and Potential Impacts

The known and potential environmental impacts of the discharge of contaminated deck water discharges are:

- Temporary and localised reduction of surrounding surface water quality; and
- Acute toxicity to marine fauna through ingestion of contaminated water.

The environment affected by contaminated deck drainage from vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the release point.

This hazard is present in Victorian state and Commonwealth waters.

Receptors that may occur within the affected environment, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

6.14.3 Evaluation of Environmental Risk

Temporary and localised reduction of surface water quality:

Traces of chemicals discharged to the ocean through open deck drainage and bilge discharges have a very low potential to temporarily reduce water quality and cause physiological damage to marine fauna that may ingest or absorb chemicals. Given the absence of sensitive habitat types in the water column of the EMBA for these discharges, the greatest risk will be to plankton and pelagic fish. Only trace quantities of contaminants would be expected in deck drainage discharges, and these would be rapidly diluted, dispersed and degraded to undetectable levels.

Acute toxicity to marine fauna:

Given the very small volumes of such chemicals or hydrocarbons (oil, grease) that may be accidentally discharged overboard, the high rates of dilution and dispersion in the open ocean environment and the temporary nature of vessel activities, it is not expected that these very small quantities of hydrocarbons would induce acute or chronic toxicity impacts to marine fauna or plankton through ingestion or absorption through the skin.

<u>Impacts to Matters of NES:</u>

The discharge of deck drainage will not have a 'significant' impact to any of the matters of NES applicable to this project.

<u>Impacts to other areas of Conservation Significance</u>:

There are no other areas of conservation significance within the environment affected by contaminated deck drainage discharges. This discharge will not have any impacts to other areas of conservation significance.

6.14.4 Environmental Impact and Control Measure Summary

Aspect:	Discharge of deck water (Vessel)
Impact summary	Pollution of surface waters. Acute toxicity to marine fauna exposed to pollution.
Extent of impact	Localised (about discharge point).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of oily water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and ensure chemical spills via deck drainage are prevented and mitigated are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Deck Chemical/Hydrocarbon Storage*: Chemical and hydrocarbons stored on open decks are stored within bunds (e.g., chemical locker, portable bunds, etc.) and portable bunds or drip trays (as appropriate) are provided for portable equipment stored in open drainage areas.
- *Detergent Selection:* Deck cleaning detergents are biodegradable and not a 'harmful substance' in accordance with MARPOL Annex III;
- *Spill Response*: The following measures are implemented to attend to spills:
    - Marine crew undertake regular training in spill response ;
    - Scupper plugs (or equivalent) are readily available to the deck crew so that open drains can be blocked in the event of a spill;
    - Spill response kits are available in relevant locations around the vessel deck/s, are fully stocked and used in the event of a spill to deck to prevent or minimise overboard discharge volumes;
    - The vessel-specific Shipboard Marine Pollution Emergency Plan (SMPEP) is implemented in the event of a large spill overboard.

6.15 Risk: Production Chemical Release

6.15.1 Hazard

The following unplanned activity has the potential to result in production chemicals being discharged to the ocean:

- Partial or full failure of the EHU due to:
    - Reverse flow of gas to umbilical (non-return valve failure).

- Impact:
  - Dropped objects.
  - Anchoring or trawling.
- Fatigue:
  - Earthquake.
  - Free span.
  - Storm damage.

The maximum volume of product of each chemical held in the EHU is:

- 4 m^3 of MEG (including scale inhibitor) (has an 'E' and 'D' non-CHARM OCNS rating respectively);
- 1.3 m^3 of methanol (has an 'E' non-CHARM OCNS rating); and
- 6 m^3 per core of hydraulic fluid (has a 'D' non-CHARM OCNS rating) (4 cores - 24 m^3 total inventory).

EHU: Given the monitoring of MEG consumption by Iona Gas Plant operators, the system alarms on EHU failure (low pressure and/or high flowrate) and process safety logic present on the hydraulic system (e.g. wellhead shut-in fail-safe closed on loss of hydraulic fluid) manual intervention by the Iona gas plant operators (e.g. injection pump shutdown) would limit the amount of EHU fluid released in the event of line failure (i.e. the complete line inventory would not be lost).

Pecten East Pipeline Failure: Failure of the Stage II pipeline section between Netherby and Pecten East may also result in the loss of inhibited water from this section of line. The volume of inhibited water within this pipeline section is 440m^3. The inhibited water contains the following chemicals:

- Oxygen Scavenger Champion OS2 (150 ppm, 0.015%) – Gold OCNS rating.
- Biocide 1710 Champion (700 ppm, 0.07%) – Gold OCNS rating.
- Champion Technologies Florescent Dye (100 ppm, 0.01%) – Gold OCNS rating.

It is noted that the CHN pipeline system normally operates at 3500 kPa(g). Given the non-compressibility of the inhibited water in the Stage II pipeline section and the double block and bleed valving isolating the CHN operating pipeline and the inhibited water section, any pressure within the inhibited water pipeline section has been present since hydro-testing the pipeline. On pipeline failure, this pressure would quickly dissipate and equalise at seabed pressure (~500-600kPa(g)) and under this scenario, only minor amounts of inhibited water would be expected to be released from the system.

6.15.2 Known and Potential Impacts

The known and potential impacts of the release of low-toxicity, highly diluted chemicals (MEG, methanol, corrosion inhibitor and hydraulic fluid) are:

- A temporary and localised reduction in water quality; and
- Toxicity to exposed marine fauna and benthic species.

Given the small volumes of chemical released and the rapid dilution which will be experienced in the high energy marine environment of the Otway Basin, the environment affected by a chemical release is expected to be localised around the discharge point.

This hazard is present in both Victorian state and Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Benthic species including filter-feeding epifauna such as sponges, macroalage and rocky hard substrate species such as bryozoans (water depths > 60 m);
- Pelagic and demersal fish; and
- Plankton.

6.15.3 Evaluation of Environmental Risk

Temporary and localised reduction of water quality:

The small volume of low toxicity chemicals that may be released from the EHU to the ocean has a low potential to temporarily reduce water quality and cause physiological damage to marine and benthic fauna that may ingest/absorb chemicals. The greatest risk will be to plankton and pelagic fish as the plume of chemicals disperse or to benthic fauna immediate adjacent to the leak site. This limited volume discharge would be rapidly diluted, dispersed and degraded to undetectable levels rapidly in the dispersive Otway marine environment.

Equally only a small volume of inhibited water from a Pecten East pipeline failure would be released to the environment, given its non-compressible nature and rapid equalisation with seabed pressures. Any discharge will be rapidly diluted and dispersed within the marine environment (negligible consequence).

Toxicity to marine fauna:

EHU: The low environmental toxicity of each chemical in the EHU, combined with their low concentrations, small volumes and the action of rapid dispersion and dilution in the open ocean will ensure no acute or chronic toxicity impacts to marine or benthic fauna or plankton through ingestion or absorption (negligible consequence).

Pecten East Inhibited Water Release: The inhibited water within this pipeline section consists of the following compounds:

- Oxygen Scavenger: The oxygen scavenger is ‘Gold’ rated in the OCNS chemical system, with a low environmental toxicity. On failure, any liquid released will be rapidly mix and dilute and will rapidly degrade as it comes into contact with oxygenated water with the surrounding seawater given the dynamic Bass Strait environment. Impacts will be highly localised and recoverable (negligible consequence).
- Biocide: The biocide within the inhibited water has an operational life of 6 years, and has not been replaced since initial dosing in 2009, so its chemical potency is likely to be degraded. The biocide utilised is OCNS ‘Gold’ rated having a low environmental toxicity to the marine environment. Selection of this chemical ensures minimal toxicity to the marine environment on release. The biocide will be rapidly diluted and will quickly mix with the surrounding seawater. Impacts will be highly localised and recoverable (negligible consequence).
- Florescent Dye: The florescent dye is OCNS ‘Gold’ rated with low environmental toxicity to the marine environment. The dye will rapidly mix and dilute with the surrounding seawater, ensuring low impact on receptors. Impacts will be highly localised and recoverable (negligible consequence).

Impacts to Matters of NES:

The discharge of production chemicals will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by a production chemical discharge. The Shelf Rocky Reef and Hard Substrates KEF may lie in the affected environment (deeper waters around wellheads).

6.15.4 Environmental Impact and Control Measure Summary

Aspect:	Production Chemical Release
Impact summary	Marine pollution, potentially leading to impacts to marine and benthic fauna.
Extent of impact	Localised around release site
Duration of impact	Temporary (rapid dispersion and dilution – hours).
Level of certainty of impact	HIGH. The impacts of production chemicals on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 and prevent/mitigate unplanned production chemical releases are:

- *Chemical selection*: Production chemicals used are in accordance with the Cooper Chemical Selection standards;
- *Navigation Charts*: CHN infrastructure is marked on hydrographic charts so vessels are aware of the marine hazard;
- *Integrity Management*: CHN infrastructure is maintained in accordance with the CHN Integrity Management Plan;
- *IMR Activity Controls*: Offshore IMR activities are undertaken in accordance with the PTW which incorporates relevant environmental controls from the campaign specific risk assessment to prevent damage to subsea infrastructure;
- *Process Shutdown*: A process shutdown system (PSD) will be implemented in the event of a chemical release from the EHU.

6.16 Risk: Displacement of Third Party Vessels

6.16.1 Hazard

The physical presence of a vessel/s undertaking IMR activities may have an adverse effect on third-party vessel operators, such as commercial fishing vessels and commercial shipping (noting that vessel presence for maintenance activities will be a rare occurrence).

Note that this section deals with interference in a socio-economic sense; collision hazard (and consequent diesel spill impacts) is addressed in Section 6.22.

Also note that interference with commercial and/or recreational divers and swimmers is not considered credible because:

- Divers – there are no recognised dive sites in the immediate vicinity of the assets.
- Swimmers – the assets are located too far from the shore.

The CHN assets are located on the northern extremity of commercial shipping lanes.

6.16.2 Known and Potential Impacts

The known and potential impacts of interference with commercial fishing vessels are:

- Displacement/disruption to transiting commercial shipping (route deviation);
- Damage to or loss of fishing equipment; and
- Loss of commercial fish catches.

The environment affected where interference with third party vessels may occur is likely to be the immediate area around the two interacting vessels or with fishing equipment.

Receptors that may occur within this area are:

- Commercial fish species;
- Fishing equipment; and
- Third-party vessels.

6.16.3 Evaluation of Environmental Risk

Disruption to third-party vessels:

Vessels undertaking IMR activities will potentially exclude other third party marine users during the activity along the CHN pipeline noting that the wellheads are located within a gazetted Petroleum Safety Zone (PSZ).

The consequence of displacing other users is considered negligible given the low usage of the area by fishermen and the location of the CHN assets at the northern extremity of commercial shipping areas. It is relevant to note that in the initial placement of the CHN pipeline, the corridor considered and minimised alignment with lobster fishing areas. It is noted in original pipeline documentation that the only seabed habitat along the alignment suitable for lobsters and abalone is the sponge reef located at KP19.5.

Other fisheries which may be present in the CHN asset area are the Victorian wrasse and snapper fishery; the Commonwealth trawl sector and shark gillnet fishery. Fishing intensity plots for the Commonwealth fisheries identify that they have a low presence in the area. Fishing intensity for state fisheries could not be obtained.

On the basis of this available information, while disruption is possible (minor consequence), with awareness controls implemented, disruption is considered remote.

Damage to or loss of fishing equipment and loss of catch:

Commercial fishermen are excluded from entering a 500-m radius PSZ around all the wellheads, as marked on navigation charts and described in nautical publications. As this is where most of the IMR or well activity works are likely to take place, no additional loss of fishing grounds is likely to occur. Consultation with relevant fishers since the gas fields have become operational has revealed no material concerns regarding the minor loss of area available to commercial fishing.

Interactions between the IMR vessel/s and other vessel traffic is likely to be minimal, mostly because of the slow moving and stationary nature of the IMR vessel, its high visibility (due to size and navigational warnings) and ease of manoeuvrability to avoid a collision. Due to this visibility, it is also unlikely that fishing gear (such as lobster pots or trawl nets) would be damaged, as fishing vessels would detour around the IMR vessel/s once communication between the vessels is made.

Given the short duration of each IMR campaign, and the existing prohibition of fishing around wellheads, the risk of damage to fishing equipment and loss of catch (negligible consequence) is considered unlikely.

Impacts to Matters of NES:

The potential interference with third-party vessels is not considered applicable to any matters of NES.

Impacts to other areas of Conservation Significance:

This hazard is not considered to be applicable to areas of conservation significance.

6.16.4 Environmental Impact and Control Measure Summary

Aspect:	IMR Vessel Presence/Displacement of Third Party Vessels
Impact summary	Vessel collision, vessel navigation disruptions, exclusion from commercial fishing grounds, loss of commercial fish catches.
Extent of impact	Highly localised (immediate area around vessels).
Duration of impact	Short-term (minutes to hours for a third-party vessel detour).
Level of certainty of impact	HIGH. Impacts associated with commercial fishing and shipping in the area is well understood. Measures implemented have been and will continue to be effective in mitigating this risk.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and ensure no incidents or complaints of spatial conflict with third party vessels during IMR activities are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Navigational Requirements (Charts):* CHN wellheads and pipeline are marked on navigation charts;
- *Navigation Requirements (PSZ)*: CHN wellheads have a PSZ gazettal;
- *Fishery Notifications (Prior to Activity):* Cooper will notify fishing industry associations of pending IMS activity one month prior to commencement and five days prior to mobilization.
- *Navigational Requirements (Vessel/Contractor):* Contractor selection verifies that vessel complies with class certification requirements under the Navigation Act 2012 and Marine Order 27 (Safety of Navigation and Radio Equipment) 2016; and Marine Order 30 (Prevention of Collisions) 2009;
- *Vessel Watch (Competency):* The vessel master and deck officers have a valid STCW certificate in accordance with *Marine Order 70 (seafarer certification)* (or equivalent) to operate radio equipment to warn of third party spatial conflicts;
- *Navigational Warnings:* AMSA Rescue Coordination Centre (RCC) is notified of the IMR survey activities 24-48 hours before operations commence, 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 to allow for the issue of a Commonwealth Notice to Mariners;
- *Navigational Warnings:* Transport Safety Victoria (TSV) is advised 4 weeks prior to IMR activity to allow for the issue of a Victorian Notice to Mariners;
- *Vessel Watch (Activity):* Visual and radar watch is maintained on the bridge at all times;

- *Spatial Conflict Incidents:* All incidents of spatial conflict will be reported to Cooper via the Cooper incident management procedure.

6.17 Risk: Introduction of Invasive Marine Species (IMS)

6.17.1 Hazard

The following activity has the potential to result in the introduction of IMS around the CHN assets:

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

While on location, the vessel/s may ballast and de-ballast to improve stability, even out vessel stresses and adjust vessel draft, list and trim, with regard to the weight of equipment on board at any one time. The Commonwealth Biosecurity department indicates that ballast water is responsible for 20-30% of all marine pest incursions into Australian waters (DAWR, 2015a). The DAWR (formerly AQIS) declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (DAWR, 2016).

Biofouling is the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWR, 2015b).

6.17.2 Known and Potential Impacts

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

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Socio-economic impacts on commercial fisheries; and
- Changes to conservation values of protected areas.

The environment affected by IMS introduction is the site of the vessel, though this can increase to more widespread suitable environments if colonisation occurs.

This hazard may occur in Victorian state or Commonwealth waters.

Receptors most at risk within this affected environment are:

- Benthic species (because their ability to move to other suitable areas is more restricted than demersal and pelagic species);
- Filter-feeding epifauna (e.g. sponges, macro-algae and rocky hard substrate species such as bryozoans (water depths > 60 m)).

6.17.3 Evaluation of Environmental Risk

Successful IMS invasion requires the following three steps:

1. Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).

2. Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
3. Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

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. 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, 2017b).

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 (DSE, 2004). 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 part of vessel contractor pre-selection, vessels mobilising from international locations or domestic vessels mobilising from ports outside the IMCRA Otway bioregion, will undertake an IMS risk assessment in accordance with the Biofouling Risk Assessment Tool developed by the WA Department of Fisheries (or equivalent assessment tool) to ensure that the risk of IMS introduction is low.

The Victorian Environment Protection (Ships Ballast Water) Regulations 2006 protects Victorian territorial seas (to 12 nm from the Victorian coastline) from discharges of high risk domestic ballast water to ensure the risk of IMS introduction is low. Domestic ballast water is ballast that originates from Australian ports or from territorial seas (to 12 nm of coastline) within Australia. Approval from the Victorian EPA is required to discharge any high-risk domestic ballast water anywhere within Victorian territorial seas. This includes, but is not limited to domestic ballast water discharges in Victorian ports.

<u>Impacts to Matters of NES:</u>

The introduction (and possible colonisation and spread) of IMS will not have a 'significant' impact to any of the matters of NES given:

- No benthic species are listed in the EPBC protected matters database. Habitat resources for pelagic species are plentiful in the region, with any colonisation of IMS in the area around the CHN assets unlikely to represent a limiting resource for threatened species;
- While giant kelp is likely to be present within the affected environment, the TEC is unlikely to exist. As such, IMS introductions are unlikely to impact on it (e.g., through uncontrolled grazing on the kelp);
- No CMRs are predicted to lie within the affected environment.

<u>Impacts to other areas of Conservation Significance</u>:

The introduction, colonisation and spread of IMS may impact on areas of conservation significance, as outlined below:

- The spread of IMS may have impact on biodiversity of non-location specific rocky reef and hard substrate areas; and
- The diverse benthic communities of The Arches Marine Sanctuary may be at risk of IMS spread (2.8 km east of pipeline).

6.17.4 Environmental Impact 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. The oil and gas industry takes a precautionary approach to IMS introduction by its adoption of all relevant Government Guidelines.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well-understood activity, good practice is 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 vessels entering and operating in Australian waters carry a low risk with respect to IMS introduction are:

- *Contractor Pre-qualification*: Cooper undertakes vessel contractor pre-qualification against the vessel requirements of the CHN Operations EP which includes biofouling risk. For vessels > 500 gross tonnes and/or less than 50 m in length, Cooper also requires an assessment against the IMCA Marine Inspection for Small Workboats;
- *Ballast Water (International Vessels):* For international vessels, ballast water exchange will occur in accordance with the Australian Ballast Water Management Requirements (DAWR, 2016) prior to entry into Australian waters;
- *IMS Risk Assessment (International Vessels and Vessels mobilizing from ports outside IMCRA Otway bioregion):* As part of Contractor pre-qualification, for international vessels and vessels mobilizing from ports outside the Otway bioregion, an IMS risk assessment in accordance with the Cooper Biofouling Risk Assessment requirements consistent with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).*Corrective actions (as required) are implemented as determined by a qualified independent third party marine pest inspector to ensure a low risk of IMS introduction;
- *International Anti-Fouling System (IAFS) Certificate (all vessels):* For vessels > 400 tonnes, vessels carry a current International Antifouling System Certificate (IAFS);
- *High risk Domestic Ballast Water Discharges (all vessels):* IMR vessels will not discharge high-risk domestic ballast water within Victorian Territorial seas (to 12 nm). This includes, but is not limited to, domestic ballast water discharges originating from Victorian ports. Domestic ballast water discharges in the IMR operational area will be assessed and undertaken in accordance with the requirements of the *EPA Protocol for Environmental Management: Domestic Ballast Water Management in Victorian Waters*.

Control measures to be implemented to control this hazard and ensure that equipment deployed into the survey area carries a low risk with respect to IMS introduction are:

- *In-water Equipment Cleaning:* All in-field equipment has been removed from the water, inspected and cleaned prior to deployment in Victorian waters.

6.18 Risk: Vessel Strike with Megafauna

6.18.1 Hazard

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

6.18.2 Known and Potential Impacts

The known and potential impacts of vessel strike to air-breathing marine megafauna are:

- Injury; and
- Death.

The environment affected by vessel strike with air-breathing marine megafauna is the immediate area of the vessel.

This hazard may occur in both Victorian state and Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Cetaceans (whales and dolphins); and
- Pinnipeds.

6.18.3 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) reviewed vessel strike data (2000-2015) for marine species in Australian waters and identified the following:

- Whales including the humpback, pygmy blue, Antarctic blue, southern right, dwarf minke, Antarctic minke, fin, bryde's, pygmy right, sperm, pygmy sperm and pilot species were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction followed by the southern right whale. A number of these species may migrate through the waters of the CHN 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 CHN 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 the seal interacting/playing with a boat, with a number of experts indicating the incidence of boat strike for seals is very low.
- All turtle species present in Australian waters are identified as interacting with vessels. The green and loggerhead species exhibited the highest incident of interaction. The presence of turtles around the CHN assets is considered remote.

Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde's whale in Bass Strait in 1992) (WDCS, 2006), though the data indicates this is more likely to be associated with container ships and fast ferries. The Whale and Dolphin Conservation Society (WDCS) (2006) also indicates that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel. The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with an animal (species not defined) (NMSC, 2010).

The DoE (2015a) reports that there was two blue whale strandings in the Victoria in the Bonney Upwelling with suspected ship strike injuries visible.

When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise 'footprint' will alert cetaceans to its presence and thus illicit avoidance.

Laist et al (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots. Vessels undertaking IMR activities will either be travelling very slowly or be stationary, thus minimising the risk of injury to cetaceans and pinnipeds.

Impacts to Matters of NES:

Vessel strike with megafauna will not have a 'significant' impact to any of the matters of NES applicable to this project. While migration, feeding, resting or breeding activities may be impacted by vessel strike, it would need to occur to many individuals before it was considered 'significant' at a population level.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected by vessel strike with megafauna.

6.18.4 Environmental Impacts and Control Measure Summary

Aspect:	Vessel strike to megafauna
Impact summary	Injury or death of cetaceans and/or pinnipeds.
Extent of impact	Limited to individuals coming into contact with the vessel.
Duration of impact	At a population level, impact is considered short-term
Level of certainty of impact	HIGH. Injury may result in the reduced ability to swim and feed. Serious injury may result in death. Impacts from cetacean and pinniped strikes have been studied and the impacts are well documented resulting in the new draft strategy document.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is 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 injuries or death to megafauna resulting from vessel collision during IMR activities are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity;
- *Vessel Management Measures:* IMR vessel monitors for marine fauna and vessel operations conform to proximity distances, speeds and vessel management practices contained in the Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8) and the Victorian Wildlife (Marine Mammals) Regulations 2009 (Part 2/Part 3) which includes:

- Vessels will travel at less than 5 knots within the caution zone of a cetacean and minimise noise (Caution Zone is 150m radius for dolphins, 300 m for whales and 50 m for pinnipeds);
- The vessel must not drift closer than 50 m (dolphin and pinnipeds) 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;
- The vessel must not restrict the path of a marine mammal;
- The vessel must not separate any individual from a group of marine mammals or come between a mother whale and calf or a seal and pup;
- If the vessel is within the caution zone of a marine mammal the vessel must with draw and move the vessel at a constant speed that does not exceed 5 knots, and avoid sudden changes in speed or direction and manoeuvre the vessel to outside the caution zone if the marine mammal shows any sign of disturbance;
- If a vessel is within the caution zone of a marine mammal, the vessel shall not approach a marine mammal from head on, from the rear or be in the path ahead of a marine mammal at an angle closer than 30° to its observed direction of travel
- 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 mammal 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 Victorian Wildlife (marine Mammals) Regulations 2009 (Part 2/Part 3) and are familiar with the requirements. This includes a requirement to notify the bridge if marine mammals are 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 to NOPSEMA/DEDJTR within 2 hrs.
- *Reporting mega-fauna injuries:* A megafauna injury will be reported to the Victorian Department of Environment, Land Water and Planning (DELWP) for assistance.
- *Other Marine User Notifications:* The vessel master shall alert other marine users of the presence of whales in the area via radio.

6.19 Risk: Accidental Release of Waste Overboard

6.19.1 Hazard

The handling and storage of materials and waste on board a vessel has the potential for accidental overboard disposal of hazardous and non-hazardous materials and waste.

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

The following non-hazardous materials and wastes will be disposed of to shore, but have the potential to be accidentally dropped or disposed overboard due to overfull bins or crane operator error:

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

The following hazardous materials may be used and waste generated through the use of consumable products and will be disposed to shore, but may be accidentally dropped or disposed overboard:

- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters);
- Batteries, empty paint cans, aerosol cans, fluorescent tubes, printer cartridges;
- Contaminated personal protective equipment (PPE); and
- Acids and solvents (laboratory wastes).

6.19.2 Known and Potential Impacts

Hazardous materials and waste to the ocean are:

- Marine pollution (litter and a temporary and localised reduction in water quality);
- Injury and entanglement of marine fauna and seabirds; and
- Smothering or pollution of benthic habitats.

The environment affected by an accidental release of hazardous and non-hazardous materials and waste may possibly extend for kilometres from the release site (as buoyant waste drifts with the currents) or localised for non-buoyant items that drop to the seabed.

This hazard is present in both Victorian state and Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Benthic species and habitat;
- Pelagic fish;
- Pinnipeds; and
- Seabirds and shorebirds.

6.19.3 Evaluation of Environmental Risk

Hazardous Materials and Waste:

Hazardous materials and wastes are defined as a substance or object that exhibits hazardous characteristics and are no longer fit for its intended use and requires disposal. Some of these hazardous characteristics (as outlined in Annex III to the Basel Convention) include being toxic, flammable, explosive and poisonous.

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical spills can impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the chemical with the surrounding seawater. In an open ocean environment such as the CHN assets, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which is likely to result in a small area of substrate becoming toxic and unsuitable for colonisation by benthic fauna. Given the size of materials release it is expected that only very localised impacts to benthic habitats across the pipeline alignment would be affected and unlikely to contribute to a significant loss of benthic habitat or species diversity.

All hazardous waste will be disposed at appropriately licensed facilities, by licenced contractors, so impacts such as illegal dumping or disposal to an unauthorised onshore landfill that is not properly lined are unlikely to result from the project.

Non-hazardous Materials and Waste:

Discharged overboard, non-hazardous wastes can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by seabirds and fish). For example, the TSSC (2015a) 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).

If dropped objects such as bins are not retrievable by ROV, these items may permanently smother very small areas of seabed, resulting in the loss of benthic habitat. However, as with most subsea infrastructure, the items themselves are likely to become colonised by benthic fauna over time (e.g., sponges) and become a focal area for sea life, so the net environmental impact is likely to be neutral. This would affect extremely localised areas of seabed and would be unlikely to contribute to the loss of benthic habitat or species diversity.

<u>Impacts to Matters of NES</u>:

The accidental disposal of hazardous and non-hazardous materials and waste to the ocean will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

<u>Impacts to other areas of Conservation Significance</u>:

Areas of conservation significance within the environment which may be affected by accidental disposal of hazardous and non-hazardous materials and waste to the ocean as detailed below:

- The Shelf Rocky Reefs and Hard Substrates KEF may lie within the environment affected by the release (deeper waters around wellheads);
- The Arches Marine Sanctuary may be within the environment affected by the release for floating waste (2.8 km east of pipeline), but its values will not be impacted by small volumes of waste that may settle on the seabed within the sanctuary.

6.19.4 Environmental Impact and Control Measure Summary

Aspect:	Release of solid/non-hazardous water 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. Non-buoyant waste may sink to the seabed near where it was lost. Buoyant waste may float long distances with ocean currents and winds.
Duration of 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.
Impact decision framework context	A. Nothing new or unusual, represents business as usual, well understood activity, good practice is 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and ensure no release of hazardous or solid waste overboard during IMR activities are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity.
- *Garbage Management Plan:* IMR vessels will operate under a Garbage Management Plan (applicable to vessels >100 GRT or certified to carry more than 15 people) which incorporates IMO requirements with respect to waste minimization, garbage handling and disposal restrictions on solid and hazardous waste.
- *Crew Induction:* Crew members are inducted into the vessel garbage management procedures to minimise the potential for unpermitted wastes being 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 vessels will comply with the requirements of *Protection of the Seas (Prevention of Pollution from Ships) Act 1983* and Marine Order (Part 95: Garbage). 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; and

- Correct segregation of solid and hazardous wastes.

6.20 Risk: Equipment loss to the Marine Environment

6.20.1 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.

6.20.2 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 (refer Section 6.3).

The environment affected by equipment loss is likely to be highly localised (non-buoyant materials) or may extend for kilometres from the release site (for buoyant or neutrally buoyant materials).

This hazard may be present in Victoria state or Commonwealth waters.

Receptors that may occur within this affected environment, either as residents or migrants, are:

- Benthic species and habitat; and
- Pelagic species (fish, pinnipeds, cetaceans).

6.20.3 Evaluation of Environmental Risk

It is possible that during the use of ROVs in survey activities, the control umbilical is 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 footprint).

In the event of seabed contact impacts to benthic species would be very localised (negligible consequence). With control measures adopted to prevent the loss of equipment it is considered unlikely this event would occur and the 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 with damage estimated at <$5M (negligible consequence). Again with control measures adopted, it is considered unlikely this event would occur and the risk is assessed as low.

Impacts to Matters of NES:

Dropped equipment and materials to the marine environment will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

Areas of conservation significance within the environment which may be affected by accidental disposal of hazardous and non-hazardous materials and waste to the ocean as detailed below:

- The Shelf Rocky Reefs and Hard Substrates KEF may lie within the environment affected by the release (deeper waters around wellheads);

- The Arches Marine Sanctuary may be within the environment affected by the release for lost equipment (2.8 km east of pipeline), but its values will not be impacted by equipment that may settle on the seabed within the sanctuary.

6.20.4 Environmental Impact 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 to ensure that seasonal sensitivities are considered in the planning of IMR activities and prevent the loss of equipment during IMR activities are:

- *IMR pre-campaign risk assessment*: This assessment will include reviewing available survey timeframes to minimise overall environmental and socio-economic impacts of the activity.
- *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.
- *In-water Equipment Retrieval:* 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).

6.21 Risk: Gas Condensate Loss of Containment (LOC)

6.21.1 Hazard

A release of hydrocarbons may occur from the CHN assets due to the following causal pathways:

- Pipeline leaks via gasket failure, valve body failure, dropped objects, anchoring or trawling or internal and external corrosion.

- Pipeline ruptures via earthquake, gasket failure, valve body failure, failure of flange studs, internal and external corrosion, pipeline fatigue due to free span, storm damage or impact damage from dropped objects, anchoring or fish trawling.
- Minor or significant wellhead leak via gasket failure, valve body failure or external corrosion.

Maximum Hydrocarbon Releases:

An assessment of the maximum credible release rates from the CHN assets based upon known reservoir conditions, pipeline inventories during normal operation and possible failure modes of the infrastructure identified the following maximum credible scenarios:

Wellhead Releases: An unconstrained flow from the lower well completion has a maximum credible flowrate based upon initial reservoir conditions of 120 MMSCFD (Santos, 2008a; 2008b). Utilising the 2017 production GOR the maximum credible initial condensate blowout rate from a CHN well is 68 BBL/d (10.7m^3/day) which decreases in flow over the spill event. Santos in 2013 undertook oil spill modelling for a maximum credible condensate blowout rate of 102 BBL/d for the CHN wells. Cooper has elected to utilise this modelling as representative of the maximum credible release rate recognising it over-represents the blowout volume.

Pipeline Release Inventory: The maximum hydrocarbons liquids retention within the CHN pipeline has been calculated at 100 m^3. This is based upon flow assurance studies (Santos, 2016) and fluid modelling studies (Santos, 2010) on the CHN pipeline. In a pipeline rupture situation, on sensing a low-low pressure downstream of the production chokes the MCS will shut-in individual wells and shutdown the well subsurface safety valve (SSSV) almost immediately. Additionally, in a rupture situation, it is unlikely the full pipeline inventory would be released given the seabed hydrostatic pressure present of 200-700 kPa(g). For modelling purposes, the worst case impact would be from an instantaneous pipeline rupture at the shoreline HDD location (assumed 10 m water depth) however a pipeline release of 100 m^3 over 24 hours has also been modelled at the offshore PLEM location.

Table 6-2 provides a summary of the hydrocarbon thresholds utilised in modelling to assess possible impacts. Table 6-3 provides the modelling results for these maximum scenarios.

Table 6-2: Hydrocarbon thresholds for impact assessment

Threshold	Supporting Literature
SEA SURFACE OILING	
LOW: 0.5-10 g/m^2 (0.5-10μm)	Threshold provides a measure of visual extent of a surface oil slick and is not at a level which measures ecological impacts. It defines a threshold of 'community concern' particularly around high tourism areas. ***Threshold has been selected to define socio-economic impacts and the surface oil EMBA.***
MODERATE: 10 - 25 g/m^2 (10 - 25μm)	Minimum thickness of oil that could impart a lethal dose to by contacting wildlife. Research has shown harm to seabirds through preening contaminated feathers or loss of thermal protection in their feathers occurs at 10μm to 25μm (French-McCay, 2009). ***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 is expected to be harmful to contacting marine birds. 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 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).

Threshold	Supporting Literature
OIL COAT: 100-1000 g/m^2	Threshold is enough to coat shoreline animals and likely impact their survival and reproductive capacity (French-McCay, 2009). Considered the ecological threshold for impacts to invertebrates living on hard and sediments. French-McCay (2009) identifies a 100μm as having potential to affect the survivability and breeding success of protected shoreline birds. Threshold is also recommended 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, 2007). ***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 is required to impact marsh plants and 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	French-McCay (2002) undertook a global review of ecotoxicity data for multiple species across a wide taxonomic range to establish toxicity effects to marine biota. This included fish, crustacean and invertebrate 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 established lethal effects concentrations to fish and invertebrates (LC_{50}). On the basis of this review, 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.
MODERATE EXPOSURE (50 ppb – 96Hr LC_{50}): 4,800 ppb-hrs	
HIGH EXPOSURE (400 ppb – 96Hr LC_{50}): 38,400 ppb-hrs	
ENTRAINED PHASE HYDROCARBONS	
LOW EXPOSURE (7 ppb – 96Hr LC_{50}): 672 ppb-hrs Very Sensitive Species (99% species protection)	This 'trigger value' of 7ppb (Total Petroleum Hydrocarbon (TPH)) (99% species protection) (ANZECC, 2000) is derived by Tsvetnenko (1998) and 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 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 a Predicted No Effects Concentration (PNEC) of 70.5 ppb (THC) (95% species protection) and 804ppb (50% species protection) were established. *The HC5 based upon chronic NOECs serves as the threshold for the protection of ecological structure, which is considered more sensitive than ecosystem functioning.* 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.
HIGH EXPOSURE (804 ppb – 96Hr LC_{50}): 77,184 ppb-hrs Tolerant species (50% species protection)	

Weathering Behaviour of Netherby-1 Condensate:

Figure 6-1 provides details on the weathering characteristics of Netherby condensate for a 100 m^3 pipeline release over a 24 hour period. The condensate rapidly evaporates on release such that surface residues are only present a few hours after the release ceases.

Figure 6-1: Predicted weathering an fate graph of Netherby Condensate based upon a 100 m^3 subsea release over 24 hours (APASA, 2013).

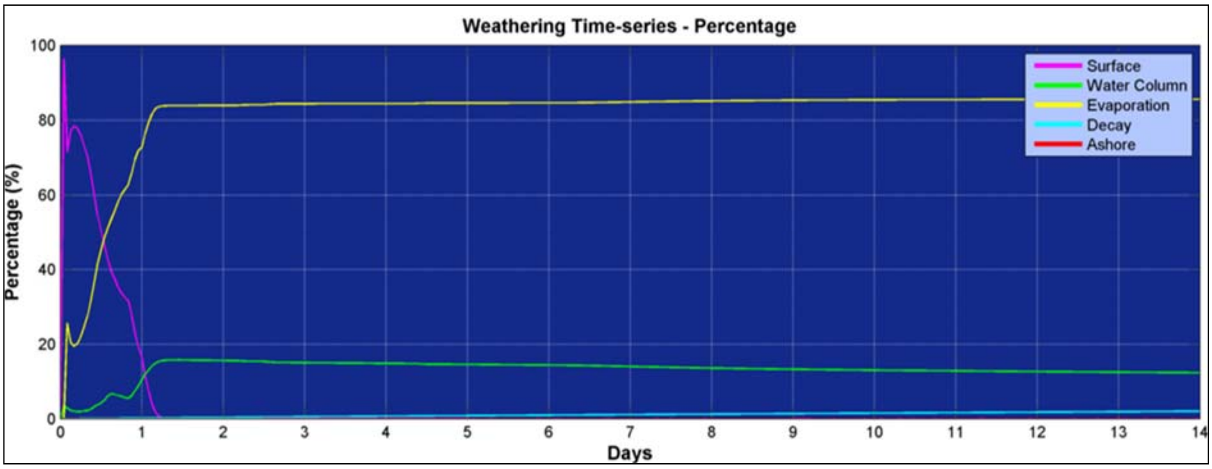


Table 6-3: Condensate modelling summary results (APASA, 2013)

Scenario	Pipeline Rupture (100m^3 release over 24 hrs – PLEM location)	Pipeline Rupture (100m^3 release instantaneous – HDD location)	Well Failure (7117 Bbl over 84 days)
SURFACE OIL			
Low Exposure	Maximum of 10.5 km travel distance from rupture site. No exposure to marine parks. No persistence longer than 25 hours.	No visible hydrocarbons after 7 hours. Concentrated within a 2.75 km distance (ENE) of the release point with a 5% chance of shoreline contact, taking 1 hour to reach the shore, resulting in a maximum stranding volume of 1.25 m^3	Maximum of 120 km travel distance from well site (east-southeast)
Moderate Exposure	Maximum of 1.4 km travel distance from rupture site.	Concentrated within a 1.2 km distance (ENE) of the release point with a 5% chance of shoreline contact, taking 1 hour to reach the shore, resulting in a maximum stranding volume of 1.25 m^3.	No sea surface or shoreline exposure.
High Exposure	Maximum of 0.5 km travel distance from rupture site.	Concentrated within a 0.5 km distance (in any direction) of the release point.	No sea surface or shoreline exposure.
DISSOLVED PHASE			
Low Exposure	No exposure of any meaningful level.	Extends up to 9.3 km from the release site, with shoreline contact.	No exposure of any meaningful level.
Moderate Exposure	No exposure of any meaningful level.	Extends up to 3.3 km from the release site, with shoreline contact.	No exposure of any meaningful level.
High Exposure	No exposure of any meaningful level.	No exposure of any meaningful level.	No exposure of any meaningful level.
ENTRAINED PHASE			

Scenario	Pipeline Rupture (100m^3 release over 24 hrs – PLEM location)	Pipeline Rupture (100m^3 release instantaneous – HDD location)	Well Failure (7117 Bbl over 84 days)
Low Exposure	Exposure zone extended to waters up to 7 km from rupture site.	A high (64%) probability of exposure at Port Campbell, with moderate probabilities at Bay of Islands (26%), Moonlight Head (30%) and Twelve Apostles Marine National Park (35%).. Maximum travel distance of 37 km.	Exposure zone extended to waters up to 4.7 km east and 3.3 km west of the rupture site. No exposure to shoreline or marine parks.
Moderate Exposure	No exposure of any meaningful level.	Low risk of exposure at Childers Cove and Bay of Island (1%), a 3% probability of exposure at Moonlight Head, 8% at the Twelve Apostles Marine National Park and a 31% probability of exposure at Port Campbell. Maximum travel distance of 9 km.	No exposure of any meaningful level.
High Exposure	No exposure of any meaningful level.	Extends to 3 km east of the release point with a 3% chance of shoreline contact at Port Campbell.	No exposure of any meaningful level.
SHORELINE RESIDUES			
Low Exposure	No exposure above threshold.	Exposure between Port Campbell and Shelley Beach (1% probability).	No exposure.
Moderate Exposure	No exposure.	Isolated exposure between Shelley Beach and Port Campbell (1% probability).	No exposure.
High Exposure	No exposure.	No exposure.	No exposure.

6.21.2 Known and Potential Impacts

The known and potential environmental impacts of a large gas condensate spill are:

- Temporary and localised reduction of surface and water column quality;
- Injury or death of marine fauna (from physical smothering, ingestion and inhalation);
- Shoreline pollution; and
- Coastal habitat degradation.

The EMBA by a gas condensate release can occur in both Victorian state and Commonwealth waters.

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic and demersal fish;
- Benthic species and filter-feeding epifauna;
- Marine mammals (cetaceans and pinnipeds);
- Seabirds and shorebirds;

- Tourism;
- Commercial fishing.

Habitat that may occur within this EMBA which support these species includes:

- Sandy beaches;
- Rocky shoreline;
- Submerged shelf rocky reefs and hard substrate;
- Macro-algal and seagrass beds; and
- Open water.

Protected areas or features that occur within the EMBA are:

- The Arches Marine Sanctuary;
- The Twelve Apostles Marine National Parks;
- The Port Campbell National Park;
- The Bay of Islands Coastal Park;
- Sub-tropical and Temperate Coastal Saltmarsh; and
- Giant Kelp Marine Forests of SE Australia TEC.

6.21.3 Evaluation of Environmental Impact

Table 6-4 provides an evaluation of environmental impact to the listed receptors based upon the modelling output in Table 6-3.

Table 6-4: Potential Impacts of Hydrocarbons on Receptors

General sensitivity to oiling – benthic assemblages (low sensitivity rating)		
Benthic species are generally protected from exposure to surface hydrocarbon however may be affected by seabed releases. The primary modes of exposure for benthic communities in oil spills include direct exposure to dispersed oil (e.g., physical smothering) where seabed discharges stay at the ocean bottom or sink down from surface; through partitioning on sediments or update through the food chain (i.e. prey) (NRDA, 2012). Surface Hydrocarbons Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle (to breed, breathe and feed). Therefore, surface hydrocarbons are not considered to pose a high risk to marine invertebrates except at locations where surface oil reaches shorelines. Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological risks. Invertebrates with no exoskeleton (limits exposure) and larval forms may be more prone to impacts. Water column/seabed hydrocarbons Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost (e.g., lobsters lost taint within 2-5 months when exposed to a light hydrocarbon (NOAA, 2002). Exposure to microscopic oil droplets may also impact aquatic biota either mechanically (especially filter feeders) or act as a conduit for exposure to semi-soluble hydrocarbons (taken up by the gills or digestive tract) (McCay-French, 2009). Toxicity is primarily attributed to water soluble PAHs. Other possible impacts from pelagic oil include oxygen depletion in bottom waters due to bacterial metabolism of oil and light deprivation under surface oil (NRDA, 2012). Abalone is a gastropod (i.e. grazer). Direct dissolved/entrained phase contact may lead to toxic impacts or impact to food sources (i.e. algal communities). Sub-lethal concentrations lead to developmental problems (slow growth and deformities) (Fingas, 2001) or narcosis (death-like appearance). The invertebrates often recover but are more vulnerable to predators or being swept away by currents. Studies of offshore benthic seaweeds in the northwest Gulf of Mexico (GoM) prior to and after the Macondo well blowout in water depths of 55-75 m found a dramatic die-off of seaweeds after the spill (Felder *et al*., 2014). Benthic decapod assemblages (crabs, lobsters, prawns) associated with the seaweeds showed a strong decline in abundance at both banks post-spill but definitive links to Macondo are not possible due to the influence of Mississippi River. Petroleum residues observed on Ewing Bank may have caused localized mortalities, reduced the fecundity of surviving female decapods or reduced recruitment (Felder *et al*., 2014). Felder et al (2014) also notes that freshly caught soft-sediment decapod samples caught in early and mid-2011 near the spill site exhibited lesions that were severe enough to cause appendage loss and mortality. Sub-lethal effects of crude oil emulsions on lobster larvae (reduced metabolism and respiratory activity) occur down to 1 ppm and concentrations of 100 ppm are lethal (Kennish, 1996). Recovery of benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (NRC, 2003).		
Potential impacts from this project		
Surface oiling	Water column/seabed	Shoreline
Not applicable.	Hydrocarbons from a well release or pipeline leak scenario are likely to make contact with the seabed within a relatively close vicinity of the source of release. Modelling of a subsea gas plume indicates that reservoir fluids released from the seabed are driven into the water column due to the momentum of the discharge with a highly localised area of contact. Offshore The modelled larger offshore scenarios (pipeline rupture and well blowout) predict no exposure from aromatics but low (effects) level entrained hydrocarbons may be experienced up to 7 km from the release site. Impact by direct contact of benthic species in the offshore release area will be localised. Filter-feeding benthic invertebrates such as sponges, bryozoans and hydroids exposed to hydrocarbons at 99% species protection levels are not expected to experience significant impacts.	There is a 1% probability of shoreline exposure to 100 g/m^2 at isolated areas of shoreline west of Port Campbell from a HDD pipeline release (no shoreline contact for the well failure scenario). Note that this is below oiling thresholds which cause ecological impacts. Inshore and intertidal benthic species may be exposed to condensate. Benthic communities associated with inshore reefs would be exposed to very low level hydrocarbons. The predicted area of shoreline contact is mixed sand/shore platform. Residues deposited on these areas are rapidly remobilised due to wave and tidal action so any accumulation is likely to be short-term and temporary.

	Near-shore The nearshore pipeline rupture scenario predicts dissolved aromatics to extend 9.3 km (low level exposure) and 3.3 km (moderate level exposures). Also moderate (effects-level) entrained hydrocarbons may extend 9 km from the spill site and low level exposures 30 km to the south-east. Based upon these results it is possible that very sensitive species (plankton, juvenile fish) may be affected by the dissolved phase plume within 9.3 km and average sensitive species affected within a 3.3 km radius. Given the HDD scenario is a limited inventory, worst case mortality impacts to sensitive species will be localised, limited in duration and not significant at a population level. For more tolerant species sub-lethal impacts may be experienced over this short-duration event. Tissue taint may remain for several months in some species (e.g., lobster, abalone), however, the CHN pipeline alignment has considered the presence of primary lobster and abalone habitats during installation and avoided most habitat suitable for these. Given the limited water column/seabed footprint associated with a seabed CHN condensate releases and the limited amount of suitable habitat in proximity to the pipeline, impacts are considered to be negligible to abalone and lobster species.	At 100 g/m^2, resident fauna such as worms, molluscs and crustaceans may suffer lethal impacts if hydrocarbons penetrate into sediments. On this basis, impacts to near-shore benthic and shoreline assemblages are considered to be limited, localised, and if impacts occur, areas will be rapidly recolonised by adjacent species (negligible impacts).

General sensitivity to oiling – plankton (low sensitivity rating)		
Plankton is found in nearshore and open waters in the water column. These organisms migrate vertically through the water column to feed in surface waters at night (NRDA, 2012). As they move close to the sea surface it is possible that they may be exposed to both surface hydrocarbons but to a greater extent, dissolved or entrained in the water column. Phytoplankton is typically not sensitive to the impacts of oil, though they do accumulate it rapidly (Hook *et al*., 2016). Phytoplankton exposed to hydrocarbons at the sea surface, may directly affect their ability to photosynthesize (& secondary effects associated with availability of light) and impacts for the next trophic level in the food chain (e.g., small fish) (Hook *et al*., 2016). Photosynthesis is stimulated by low concentrations of oil in the water column (10-30 ppb), but become progressively inhibited above 50 ppb. Conversely, photosynthesis can be stimulated below 100 ppb for exposure to weathered oil (Volkman *et al*., 2004). Zooplankton (microscopic animals such as rotifers, copepods and krill that feed on phytoplankton) is vulnerable to hydrocarbons (Hook *et al*., 2016). Water column organisms that come into contact with oil risk exposure through ingestion, inhalation and dermal contact (NRDA, 2012), which can cause immediate mortality or declines in egg production and hatching rates along with a decline in swimming speeds (Hook *et al*., 2016). Plankton is generally abundant in the upper layers of the water column and is the basis of the marine food web, so an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Reproduction by survivors or migration from unaffected areas is likely to rapidly replenish losses (Volkman *et al*., 2004). Oil spill field observations show minimal or transient effects on plankton (Volkman *et al*., 2004). Once background water quality is re-established, plankton takes weeks to months to recover (ITOPF, 2011a). Planktonic Eggs: Some corals, fish and other marine organisms (e.g. abalone) are broadcast spawners eggs are released into the water column to be fertilised with the eggs then staying in the upper water column while the embryo develops. Because of their small size and high lipid content, eggs accumulate hydrocarbons from the dissolved phase rapidly and are sensitive to PAH concentrations down to 0.5µg/l. Primary commercial fish species in the area are abalone (broadcast spawners between October to April) and Rock Lobster (egg hatching between September and November). Most recruitment of lobster larvae into Victorian waters is from South Australia (i.e. rapid replacement). For lobsters it is noted that waters contain a number of larval cohorts at all times of the year. Porifora (sponges) spawn in spring/summer period. Given the rapid replacement of waters within the Otway Basin from the Leeuwin Current, larval impacts at a population level are not expected.		
Potential impacts from this project		
Surface oiling	Water column	Shoreline

Plankton and planktonic eggs are expected to be widely represented within waters of the wider Bass Strait region. Plankton is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by dissolved and dispersed hydrocarbons. Once background water quality conditions are re-established, plankton is expected to recover rapidly through recruitment from surrounding waters. The overall impact of hydrocarbon spills on plankton is not considered to be significant in the long-term (negligible consequence). <u>Well failure scenario</u> Modelling predicts a low level surface sheen may occur in the event of a well failure extending to 120 km from the site. Plankton in this footprint may suffer mortality. <u>Pipeline rupture scenario</u> Modelling predicts a HDD pipeline rupture may create a surface sheen of approximately 3 km with greater surface thicknesses adjacent to the release location (0.5km). Moderate zones of dissolved phase hydrocarbons can also to 9.3 km which may lead to lethal impacts to plankton. In this case, mature individuals and early life stages (larvae, gametes and juveniles) may experience some mortality upon exposure. This limited footprint is not expected to have a significant impact on plankton or planktonic fish species. This exposure is temporary and recoverable (negligible consequence).	Not applicable.

General sensitivity to oiling – pelagic fish (low sensitivity rating)
The behaviours and habitat preferences of fish species determine their potential for exposure to hydrocarbons and the resulting impacts. Demersal species may be susceptible to oiled sediments, particularly species that are site restricted. Pelagic species that occupy the water column are more susceptible to entrained and dissolved hydrocarbons, however generally are highly mobile and not likely to suffer extended exposure due to their patterns of movement. The exception would be in areas such as reefs and other seabed features where species are less likely to move away into open waters (i.e., site-attached). Fish are exposed to hydrocarbon droplets through a variety of pathways, including: Direct dermal contact with diffusion across their gills (Hook *et al*., 2016)); Ingestion of contaminated prey; and Inhalation (e.g., elevated dissolved contaminant concentrations in water passing over the gills). Exposure to hydrocarbons can be toxic to fish. Studies have shown a range of impacts including changes in abundance, decreased size, inhibited swimming ability, changes to oxygen consumption and respiration, changes to reproduction, immune system responses, DNA damage, visible skin and organ lesions, and increased parasitism. However, many fish species can metabolise toxic hydrocarbons, reducing the risk of bioaccumulation in the food web (and human exposure to contaminants through the consumption of seafood) (NRDA, 2012). Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling and burrowing behaviour (Kennish, 1996). However, high mobile fish are unlikely to remain in the area of a spill for sufficient time to be exposed to sub-lethal doses. Since fish and sharks do not generally break the sea surface, surface hydrocarbons impact to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks with fish mortalities rare in open waters (Volkman *et al*., 2004). Adult fish kills reported after oil spills occur mainly to shallow water, near-shore benthic species (Volkman *et al*., 2004). Hydrocarbon in the water column can physically affect reef fish (site attached) exposed for an extended duration (weeks to months) by coating of gills/body surfaces, leading to lethal and sub-lethal effects from reduced oxygen exchange and irritation and infection. Ingestion of oil droplets/contaminated food may lead to reduced growth (Volkman *et al*., 2004). Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm. The majority of studies, either from laboratory trials or of fish collected after spill events find evidence of elimination of PAHs in fish tissues returning to reference levels within two months of exposure (Challenger and Mauseth, 2011; Gagnon & Rawson, 2011; Gohlke *et al*., 2011; Jung *et al*., 2011; Law *et al*., 1997; Rawson *et al*., 2011). Squid are widely distributed, however, when squid reach maturity at 1-2 years, they move inshore to spawn in large numbers and then die after spawning. Where large numbers of squid spawn in small areas, the population could be impacted by the reduction in successful spawn. As squid are generally abundant and reach sexual maturity rapidly, recovery is expected to be rapid (1-2 years) (Minerals Management Service, 1983). No reported studies of the impacts of oil spills on cartilaginous fish (including sharks, rays and sawfish) were found in the literature. It is not known how the data on the sensitivity of bony fishes would relate to toxicity in cartilaginous fishes. All EPBC Act-listed sharks in the EMBA are viviparous or ovoviviparous and so do not have a free-swimming larval stage. These species are also larger than the bony fish species for which toxicity has been studied.

The assessment of effects on fish species in the Timor Sea as a result of the Montara well blowout (a light gas condensate), conducted from November 2009 to November 2010 undertaken by Gagnon & Rawson (2011), found that of the species studied (mostly goldband snapper, red emperor, rainbow runner and Spanish mackerel) were in good physical health at all sites, suggesting good health status. Gagnon & Rawson (2011) concluded that there were no detectable petroleum hydrocarbons found in the fish muscle samples, limited ill effects were detected in a small number of individual fish, and no consistent adverse effects of exposure on fish health could be detected within two weeks following the end of the well release. Notwithstanding, fishes from close to the Montara well, collected seven months after the discharge began, showed continuing exposure to hydrocarbons in terms of biomarker responses. Two years after the discharge, biomarker levels in fishes had mostly returned to reference levels, except for liver size.

Sampling from January 2010 to June 2011 by the University of South Alabama and Dauphin Island Sea Lab found no significant evidence of diseased fish in reef populations off Alabama or the western Florida Panhandle as a result of the Montara well blowout (BP, 2014).

Potential impacts from this project		
Surface oiling	Water column	Shoreline
The majority of adult fish, including sharks, tend to remain in the mid-pelagic zone and are not likely to come into contact with surface hydrocarbons. It is possible that some near-shore species (e.g. some syngnathid species) associated with nearshore rocky reefs and rafts of floating seaweed may come into contact with surface oil if present through entrainment, however given the dynamic nature around near-shore reefs exposure is not considered to be significant. Any impacts from surface oiling on fish are considered to be negligible at a population level.	Ingestion of hydrocarbons in the water column is possible for adults and juveniles in the mid-pelagic zone, however generally these species are highly mobile and as such are not likely to suffer extended exposure. Hook et al (2016) states that high concentrations of dissolved hydrocarbons are required to cause outright fish mortality. Large scale population level impacts of unplanned discharges on fish species, abundances or assemblage composition would be unlikely due to the wide geographical distribution of many fish in Bass Strait. Offshore (Well failure and PLEM failure scenario) The very small zone of low exposure entrained hydrocarbon from a well failure or pipeline rupture is unlikely to result in impacts at the population level for any fish residing in or swimming through a hydrocarbon plume. This includes the EPBC Act-listed great white shark may be exposed to hydrocarbons in the water column if present at or soon after a well release. The EMBA does not represent a key feeding or breeding area, and given the mobility of the species mortality of individuals or populations related to acute or chronic toxicity (or effects through consumption of exposed prey) is unlikely (negligible impacts). Pipeline rupture scenario Given the location of pipeline rupture, it is likely that shallow inshore species, such as syngnathids and other site-attached species may be exposed to moderate to high levels of entrained and low-to-moderate levels of dissolved phase hydrocarbons. As the condensate will not have much time to weather (and lose the toxic MAH and PAH components), there may be some mortality of individuals exposed to freshly released hydrocarbons if they cannot move out of the plume. The area of impact is limited and short-term and while localised mortality is possible, at a population level, the impact is not expected to be significant.	Not applicable.

General sensitivity to oiling – cetaceans (high sensitivity rating)
Whales and dolphins can be exposed to the chemicals in oil through: internal exposure by consuming oil or contaminated prey; inhaling volatile oil compounds when surfacing to breathe; dermal contact, by swimming in oil and having oil directly on the skin and body; and maternal transfer of contaminants to embryos (NRDA, 2012; Hook *et al*., 2016). The effects of this exposure include: hypothermia due to conductance changes in skin, resulting in metabolic shock (expected to be more problematic for non-cetaceans in colder waters); toxic effects and secondary organ dysfunction due to ingestion of oil; congested lungs; damaged airways; interstitial emphysema due to inhalation of oil droplets and vapour; gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding; eye and skin lesions from continuous exposure to oil; decreased body mass due to restricted diet; and stress due to oil exposure and behavioural changes. French-McCay (2009) identifies a 10-25 µm oil thickness has the potential to impart a lethal dose on marine species, however estimates a probability of 0.1% mortality to cetaceans at these thresholds based on the proportion of the time spent at surface. Direct surface oil contact is considered to have little deleterious effect on whales, possibly due to the skin's

effectiveness as a barrier to toxicity, and oil on cetacean skin is probably minor and temporary (Geraci & St Aubin, 1982). Cetaceans have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces. Oil tends to adhere to rough surfaces, hair or calluses of animals, so contact may cause only minor hydrocarbon adherence.

The physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are applicable to entrained oil. The susceptibility of cetaceans varies with feeding habits. Baleen whales (such as blue, southern right and humpback whales) are not particularly susceptible to ingestion of oil in the water column, but are susceptible to oil at the sea surface as they feed by surface skimming. Oil may stick to the baleen while they 'filter feed' near slicks. Sticky, tar-like residues are particularly likely to foul the baleen plates.

The inhalation of oil droplets, vapours and fumes may occur if whales surface in slicks to breathe. Exposure can damage mucous membranes, airways or even cause death.

Toothed whales and dolphins may be susceptible to ingestion of dissolved and entrained oil as they gulp feed at depth. There are reports of declines in the health of individual pods of killer whales, though not the population as a whole, in Prince William Sound after the Exxon Valdez spill (heavy oil) (Hook *et al*., 2016).

It has been stated that pelagic species will avoid hydrocarbon, mainly because of its noxious odours, but this has not been proven. The strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. So weathered or tar-like oil residues, typical of some crude oil and heavy fuel oil spills, can still present a problem by fouling baleen whales feeding systems.

Dolphin populations from Barataria Bay, Louisianna, USA, which were exposed to prolonged and continuous oiling from the Macondo oil spill in 2010, had higher incidences of lung and kidney disease than those in the other urbanised environments (Hook *et al*., 2016). The spill may have also contributed to unusually high perinatal mortality in bottlenose dolphins (Hook *et al*., 2016).

As highly mobile species, in general it is very unlikely that cetaceans will be exposed to concentrations for continuous durations (e.g., >96 hours) lead to chronic toxicity effects.

Potential impacts from this project		
Surface oiling	Water column	Shoreline
Modelling predicts surface oil sheens from CHN infrastructure release scenarios, except for the HDD pipeline rupture where high exposures may occur within 0.4km of the release location. For the near-shore pipeline rupture surface hydrocarbons would not be expected after 7 hours of the release (temporary). The HDD area is located in the BIA for nearshore migration of southern right whales and does not overlap the nearby aggregation BIA for southern right whales. Additionally a low-level surface sheen from offshore spills overlaps the foraging BIA for the pygmy blue whale (if the spill occurs during their main feeding period of November to May). Zooplankton is able to ingest hydrocarbon particles and rapidly process them (Volkman *et al*., 1994), so if large quantities of affected prey were ingested, it is possible sub-lethal or chronic toxicity impacts to pygmy blue whales may occur. Physical contact with very localised areas of surface sheens are unlikely to lead to any long-term impacts, with temporary skin irritation and very light fouling/matting of baleen plates likely to occur (it is unknown whether the latter would affect feeding ability). Population level effects on the pygmy blue whale (or any other cetaceans species present) are considered unlikely (negligible consequence).	The zones of potential dissolved and entrained hydrocarbons for the pipeline rupture and well failure scenarios are highly localised. Cetaceans migrating through these zones, especially southern right whales during their predicted nearshore migration may ingest contaminated water and plankton. The biological consequences of physical contact with localised hydrocarbons in the water column are unlikely to lead to any long-term impacts, with temporary skin irritation being the most likely effect. For offshore releases (wellhead and pipeline) the entrained phase levels are very low and effect-level impacts to whales would be unlikely. For the nearshore release, higher concentration exposure may be experienced during coastline migrations however this would be on a very localised basis and temporary in nature. Population level effects on migrating southern right whales (and other species that may be present) are considered unlikely (negligible consequence).	Not applicable.

General sensitivity to oiling – pinnipeds (medium sensitivity rating)
<u>Sea surface oil</u>

Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water. Pinnipeds are also sensitive as they will stay near established colonies and haul-out areas and are less likely to practice avoidance behaviours. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation.

As a result of exposure to surface oils, pinnipeds, with their relatively large, protruding, eyes are particularly vulnerable to effects such as irritation to mucous membranes and the oral cavity, respiratory surfaces, and anal and urogenital orifices. Hook et al (2016) reports that seals appear not to be very sensitive to contact with oil, but instead to toxic impact from the inhalation of volatile components.

For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulation value by removing natural waterproofing oils. The rate of heat transfer through fur seal pelts can double after oiling (Geraci & St. Aubin, 1988). Fur-seals are particularly vulnerable due to the likelihood of oil adhering to fur. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water.

<u>In-water oil</u>

Ingested hydrocarbons can irritate or destroy epithelial cells that line the stomach and intestine, thereby affecting motility, digestion and absorption. However, pinnipeds have been found to have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison *et al*., 1986). Volkman et al (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death.

<u>Shoreline oil</u>

Breeding colonies used to birth and nurse until pups are weaned are particularly sensitive to hydrocarbon spills (Higgins & Gass, 1993). Pinnipeds are further at risk because of their tendency to stay near established colonies and haul out areas and unlikely to practice oil avoidance behaviours. It is reported that most pinnipeds scratch themselves vigorously with their flippers and do not lick or groom themselves, so are less likely to ingest oil from skin surfaces (Geraci & St. Aubin, 1988). However, mothers trying to clean an oiled pup may ingest oil. The *Iron Barren* oil spill which released 550 tonnes of heavy fuel oil (in Tasmania, 1995) concluded a strong relationship between the productivity of the seal colonies and the proximity of the islands to the oil spill where the islands close to the spill showed reduced pup production (Tasmanian SMPC, 1999).

Pinnipeds appear to rely on scent to establish a mother-pup bond (Sandegren, 1970; Fogden, 1971).Oil-coated pups may not be recognisable to their mothers. This is a theory with studies and research indicating interaction between mothers and oiled pups were normal (Davis and Anderson, 1976; Shaughnessy & Chapman, 1984).

Due to the extreme philopatry of females and limited dispersal of males between breeding colonies, the removal of a few individuals annually may increase the likelihood of decline in some of the smaller colonies. Extinction of breeding colonies further reduces genetic diversity.

Potential impacts from this project		
Surface oiling	Water column	Shoreline
Localised parts of the foraging range for New Zealand and Australian fur-seals may be temporarily exposed to low concentrations (1 – 10 g/m²) of hydrocarbon at the sea surface (silvery sheen up to metallic appearance). Exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. The extent that this results in permanent injury or mortality is unknown, but given the absence of breeding colonies and haul-out sites within the EMBA, injuries and mortality are unlikely (negligible consequence).	Fur-seals tend to forage in deeper waters of the CHN asset area. Localised parts of the foraging range for New Zealand and Australian fur-seals may be temporarily exposed to low exposure levels of entrained hydrocarbon in the water column. This exposure or consumption of prey affected by oil is unlikely given the low exposure zones and rapid loss of the volatile components of condensate in choppy and windy seas (such as that of the EMBA). Impacts at the population level are not considered likely (negligible consequence). Water quality at the only seal haul-out site in the EMBA (Moonlight Head/Cape Volney) is predicted to be low level (effects level) entrained hydrocarbons. These levels of hydrocarbon are not expected to significantly impact the species.	Small colonies of New Zealand and Australian fur-seals occur at Lady Julia Percy Island, outside of the EMBA and at Moonlight Head/Cape Volney which is located in the entrained phase EMBA. Modelling predicts no shoreline stranding of hydrocarbons at these locations. A small section of shoreline between Port Campbell and Peterborough (shelly beach) is predicted to be contacted by condensate residues above 100 g/m² from a HDD pipeline rupture however OSRA mapping indicates there are no fur-seal colonies or haul-out locations along this stretch of coastline. No impacts from shoreline hydrocarbon residues are expected.

General sensitivity to oiling – marine reptiles (medium sensitivity rating)		
Marine reptiles can be exposed to hydrocarbon through ingestion of contaminated prey, inhalation or dermal exposure (Hook *et al*., 2016). Sea turtles are vulnerable to the effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults in nearshore waters. Several aspects of sea turtle biology and behaviour place them at particular risk, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large pre-dive inhalations. Effects of oil on turtles include increased egg mortality and developmental defects, direct mortality due to oiling in hatchlings, juveniles, and adults; and negative impacts to the skin, blood, digestive and immune systems, and salt glands. Turtles may be exposed to chemicals in oil in two ways: internally – eating or swallowing oil, consuming prey containing oil based chemicals, or inhaling of volatile oil related compounds; and externally – swimming in oil or oil on skin and body. Ingested oil may cause harm to their internal organs. Oil covering their bodies may interfere with breathing because they inhale large volumes of air to dive. Oil can enter cavities such as the eyes, nostrils, or mouth. Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Short, 2011). An exception to this was the large number of marine turtles collected (613 dead and 536 live) during the Macondo spill in the GoM, although many of these animals did not show any sign of oil exposure (NOAA, 2011; 2013). Of the dead turtles found, 3.4% were visibly oiled and 85% of the live turtles found were oiled (NOAA, 2013). Of the captured animals, 88% of the live turtles were later released, suggesting that oiling does not inevitably lead to mortality. No nesting beaches are in proximity to the CHN EMBA.		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
Marine turtles in Victoria that are not rare vagrants are deep-water species (i.e. leatherback). Given the limited areas of surface sheen from the offshore CHN (well blowout and PLEM rupture) it is possible some individual marine reptiles may come into contact with localised areas of low hydrocarbons. Based on literature, this may result in sub-lethal impacts such as irritation of skin or cavities. However, due to the sparse nature of turtles within the Otway Basin, encounter is unlikely and also unlikely to impact at a population level.	The sparse population of marine reptiles in the EMBA combined with the localised extent of low hydrocarbon exposure from the offshore release scenarios (wellhead and pipeline) would indicate negligible impacts to marine reptile populations from low level exposure entrained phase hydrocarbons.	There are no known turtle nesting beaches within the EMBA, so impacts from shoreline oiling will not occur.

General sensitivity to oiling – seabirds and shorebirds (high sensitivity rating)
Seabirds and shorebirds are sensitive to the impacts of oiling, with their vulnerability arising from the fact that they cross the air-water interface to feed, while their shoreline habitats may also be oiled (Hook *et al*., 2016). Birds foraging at sea have the potential to directly interact with oil on the sea surface in the course of normal foraging activities. Species most at risk include those that readily rest on the sea surface (such as shearwaters) and surface plunging species such as terns and boobies. As seabirds are top order predators, any impact on other marine life (e.g., pelagic fish) may disrupt and limit food supply both for the maintenance of adults and the provisioning of young. In the case of seabirds, direct contact with hydrocarbons is likely to foul feathers, which may result in hypothermia reducing the ability of the bird to thermo-regulate, impairs water-proofing, may result in impaired navigation and flight performance (Hook *et al*., 2016), and result in dehydration, drowning and starvation (DSEWPC, 2011; AMSA, 2013). Toxic effects of hydrocarbons may result when ingested as the bird attempts to preen its feathers. Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbon consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. Studies of contamination of duck eggs by small quantities of crude oil have been shown to result in mortality of developing embryos. Engelhardt (1983), Clark (1984), Geraci & St Aubin (1988) and Jenssen (1994) indicated that the threshold thickness of oil that could impart a lethal dose to some intersecting wildlife individual is 10 µm (~10 g/m^2). Scholten et al (1996) indicates that a layer 25 µm thick would be harmful for most birds that contact the slick.

Shorebirds are likely to be exposed to oil when it directly impacts the intertidal zone due to their feeding habitats. Shorebird species foraging for invertebrates on exposed sand and mud flats at lower tides will be at potential risk of both direct impacts through contamination and indirect impacts through a reduction in available prey items (Clarke, 2010). Breeding seabirds may be directly exposed to oil via a number of potential pathways. Any direct impact of oil on terrestrial habitats has the potential to contaminate birds present at the breeding sites (Clarke, 2010). Bird eggs may be damaged if an oiled adult sits on the nest (Clarke, 2010). Penguins may be especially vulnerable to oil because they spend a high portion of their time in the water and readily lose insulation and buoyancy if their feathers are oiled (Hook *et al.*, 2016). The Iron Baron spill (325 tonnes of bunker fuel in Tasmania in 1995) is estimated to have resulted in the death of up to 20,000 penguins (Hook *et al.*, 2016).		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
A significant number of albatross, petrel and shearwater bird species, together with the Australasian gannet have BIAs within the EMBA of the offshore and nearshore CHN release scenarios. These birds forage over an extensive area and are distributed over a wide geographic area. Modelling predicts that most surface oiling occurs at surface sheens which are unlikely to affect seabirds. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with a localised area of low surface oil exposure. Contact with areas of high and medium hydrocarbon exposure is highly unlikely. As such, acute or chronic toxicity impacts (death or long-term poor health) to bird species at the individual level, let alone population level, are unlikely (minor consequence). The HDD pipeline rupture modelling predicts higher levels of surface oiling, with moderate oiling within 1.2 km of the release site. This impact is localised and predicted to last for 7 hrs only which limits potential impacts to these bird species.	Impacts to birds from water column hydrocarbons is unlikely without first being exposure to surface oiling. This exposure route is not considered as significant as direct contact with hydrocarbons on the sea surface or at the shoreline. Penguin colonies feed in the area and may be exposed by the offshore release scenarios (well blowout and PLEM rupture) to large areas of low exposures of entrained hydrocarbon but given that their wide ranging foraging habitats and their nightly return to burrows at the shore, they are unlikely to remain within the entrained phase plumes. This is unlikely to be enough time to cause significant oiling, but preening once onshore may increase exposure to toxic elements. Penguin colonies within the HDD pipeline rupture EMBA are present at Murmane Bay/Flaxman Hill and Bay of Islands (containing low level entrained phase exposure); London Bridge (containing both low and moderate entrained and dissolved phase plumes) and the Twelve Apostles (containing low level entrained phase exposure). As prey is caught with rapid jabs of the penguin's beak and swallowed whole, it is possible that the penguin may ingest small volumes of low and moderate levels of dissolved phase hydrocarbons, if feeding in the localised area affected. Also prey (school fish, squid of krill) affected by the spill when ingested may lead to sub-lethal impacts. It is possible that individual birds at specific locations (e.g. London Bridge) may be affected by such a near-shore spill, however given the temporary nature of the spill, its localised footprint and the large foraging areas of penguin, individual birds may be affected but it is not considered significant at a population level.	Modelling predicts a 1% probability of shoreline exposure to 100 g/m^2 at isolated areas of shoreline west of Port Campbell from a 100 m^3 subsea pipeline release (no shoreline contact for the well failure scenario). Note that this is below oiling thresholds which cause ecological impacts. The area of shoreline predicted to be exposed to hydrocarbon loadings >100g/m^2 are localised and lie between Port Campbell and London Bridge on a mixed sand/shore platform shoreline. Residues deposited on these areas are rapidly remobilised due to wave and tidal action so any accumulation is likely to be short-term and temporary. For sand areas, weathered condensate resides, similar to MDO would be expected to percolate into the sub-strata of the beach, also limiting exposure to shoreline species. Hooded plovers are recorded as occurring in this area. Shorebirds foraging for food in intertidal areas, along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering nests can reduces the survivability of hatchlings. Given the low levels of hydrocarbon accumulation predicted (153 g/m^2), the limited area and temporary nature of exposure, it is considered that while individual birds may be affected, at a population level this is not significant (minor consequence).

General sensitivity to oiling – sandy beaches (low sensitivity rating)
Sandy beaches have a 'Low' sensitivity rating as they are regularly cleaned by wave action have low total organic carbon and low abundance of marine life (Hook *et al.*, 2016). The 100 ml/m^2 threshold (considered a 'stain' or 'film', and equivalent to 0.1 mm) is assumed as the lethal threshold for invertebrates on hard substrates and sediments (mud, silt, sand, gravel) in intertidal habitats. A threshold of 100 g/m^2 oil thickness would be enough to coat the animal and likely impact its survival and reproductive capacity (French-McCay, 2009). Based on this, areas of heavy oiling would likely result in acute toxicity, and death, of many invertebrate communities, especially where oil penetrates into sediments through

animal burrows (IPIECA, 1999). However, these communities would be likely to rapidly recover (recruitment from unaffected individuals and recruitment from nearby areas) as oil is removed from the environment. Sandy beaches support a variety of worms, molluscs and crustaceans. Because the sand retains oil, such animals may be killed if oil penetrates into the sediments. For example, following the *Sea Empress* spill (in west Wales, 1996) many amphipods (sandhoppers), cockles and razor shells were killed. There were mass strandings on many beaches of both intertidal species (such as cockles) and shallow sub-tidal species. Similar mass strandings occurred after the *Amoco Cadiz* spill (in Brittany, France, 1978) (IPIECA, 1999). Following the *Sea Empress* spill, populations of mud snails recovered within a few months but some amphipod populations had not returned to normal after one year. Opportunists such as some species of worm may actually show a dramatic short-term increase following an oil spill (IPIECA, 1999). Long-term depletion of sediment fauna could have an adverse effect on birds or fish that use tidal flats as feeding grounds (IPIECA, 1999).
Potential impacts from this project
Shoreline
There is a very small area between Port Campbell and Shelly Beach where modelling predicts shoreline oiling may occur above 100 g/m^2 may occur (1% probability of contact). This area is dominated by sheer rocky cliffs with very small areas of sandy beach/rock platform. This occurs only for the pipeline rupture scenario at the HDD. With the shortest time to reach the coast being 1 hour, the hydrocarbons will have partially weathered. Impacts to amphipods or worms on sandy beaches from smothering and oxygen depletion are unlikely to occur in the low concentrations and volumes (1.25 m^3 maximum) predicted to strand ashore. Given the low viscosity of this residue it is likely to permeate into sand areas in a similar way to MDO. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline (negligible consequence). Impacts to tourism and other human uses of the beach are unlikely. Visual impact through shoreline staining is unlikely to occur (minor consequence based upon business reputation parameter).

General sensitivity to oiling – rocky shores (low sensitivity rating)
Rocky shores have a 'Low' sensitivity rating as hydrocarbons are generally quickly removed by incoming tides and waves. Cracks and crevices, rock pools, overhangs and other shaded areas provide habitat for soft bodied animals such as sea anemones, sponges and sea-squirts, and become places where oil can become concentrated as it strands ashore (Hook *et al*., 2016). Rich animal communities underneath the rocks are also the most vulnerable to oil pollution. The vulnerability of a rocky shoreline to oiling is dependent on its topography and composition as well as its position. A vertical rock wall on a wave-exposed coast is likely to remain unoiled if an oil slick is held back by the action of the reflected waves. At the other extreme, a gradually sloping boulder shore in a calm backwater of a sheltered inlet can trap enormous amounts of oil, which may penetrate deep down through the substratum. The complex patterns of water movement close to rocky coasts also tend to concentrate oil in certain areas. Some shores are well known to act as natural collection sites for litter and detached algae, and hydrocarbons are carried there in the same way. As on all types of shoreline, most of the oil is concentrated along the high tide mark while the lower parts are often untouched (IPIECA, 1995). The impact of oil on any marine organism depends on the toxicity, viscosity and amount of oil, on the sensitivity of the organism and the length of time it is in contact with the oil. Even where the immediate damage to rocky shores from oil spills has been considerable, it is unusual for this to result in long-term damage and the communities have often recovered within 2 or 3 years (IPIECA, 1995). This is because oil is not normally retained on rocky shores in a form or quantity that causes long-term impacts and also because most rocky shore species have a considerable potential for re-establishing populations. Brown seaweeds, for example, are relatively insensitive to oil due to the slimy mucilage that coats all their surfaces. Many rocky shore animals have also been found to withstand heavy oiling, and it typically requires smothering by a viscous oil for a few tides to fatally impact barnacles and intertidal sea anemones. Limpets, littorinid snails and other grazing molluscs, however, are usually more susceptible, and a toxic oil may cause a large numbers of fatalities. This may be a direct effect or through the narcotic effect of the oil which causes the animals to lose their grip on the rock and become available to predators or die of desiccation (IPIECA, 1995). As long as the shore is not contaminated by further oiling, the spores of macroalgae also settle and grow resulting in an abnormally dense cover of seaweeds. At the same time, the juvenile limpets and snails, which settle and develop in damp and protected sub-habitats, move out onto the open rock to gradually repopulate the vacant areas. They grow quickly on the large quantities of food and gradually reduce the seaweed cover to normal levels. The whole process may take less than 2 or 3 years for the shore to look 'normal', although in some cases the balance between algae and grazers may take longer to stabilise (IPIECA, 1995).
Potential impacts from this project

Shoreline
There is a very small area between Port Campbell and Shelly Beach where modelling predicts that shoreline oiling may occur above 100 g/m^2 may occur (1% probability of contact). This area is dominated by sheer rocky cliffs with very small areas of sandy beach/rock platform. This occurs only for the pipeline rupture scenario at the HDD. With the shortest time to reach the coast being 1 hour, the hydrocarbons will have partially weathered. Impacts from smothering and oxygen depletion are unlikely to occur in the low concentrations and volumes (1.25 m^3 maximum) predicted to strand ashore. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline (negligible consequence).

General sensitivity to oiling – macroalgal communities (medium sensitivity rating)		
Macroalgae are generally limited to growing on intertidal and subtidal rocky substrata in shallow waters to 10 m depth. As such, they may be exposed to subsurface and entrained and dissolved hydrocarbons however are susceptible to surface hydrocarbon in intertidal habitats as opposed to subtidal habitats. Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer, 1971; Cintron *et al*., 1981). In macroalgae, oil can act as a physical barrier for the diffusion of carbon dioxide across cell walls (O'Brian & Dixon, 1976). The effect of hydrocarbons however is largely dependent on the degree of direct exposure and how much of the hydrocarbon adheres to algae (i.e. oil 'stickiness'). A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of variability in impact, but in all instances, the algae recovered rapidly from even after very heavy oiling. The rapid recovery of algae was attributed to the fact that for most algae, new growth is produced from near the base of the plant while the distal parts (which would be exposed to the oil) are continually lost. Other studies have indicated that oiled kelp beds had a 90% recovery within 3-4 years of impact, however full recovery to pre-spill diversity may not occur for long periods after the spill (French-McCay, 2003). Intertidal macroalgal beds are more prone to oil spills than subtidal beds because although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy can increase the persistence of the oil impacting upon site-attached species. Hook et al (2016) states that kelp is typically relatively resistant to oil, though the fauna associated with it may be more sensitive. Toxic effect concentrations to macro-algae have varied greatly among species and studies, ranging from 0.002–10,000 ppm (Lewis & Pryor, 2013). The sensitivity of gametes, larva and zygote stages however have all proven more responsive to petroleum oil exposure than adult growth stages (Thursby & Steele, 2003; Lewis & Pryor, 2013). Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. In addition to the potential impacts from direct smothering or exposure to entrained and dissolved hydrocarbons, the presence of entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes to photosynthesise.		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
Macroalgal communities are generally restricted close to shore (see 'shoreline' column to the right). Offshore condensate releases are not predicted to result in surface oiling to macroalgae. No Giant kelp forest TEC areas are present in the offshore or HDD pipeline rupture EMBAs.	Giant Kelp Forest TEC areas have not been identified within the EMBA area affected by condensate releases. Impacts to macro-algal communities present are likely to be similar to the general sensitivity observations noting that the rough seas of the nearshore environment will result in rapid weathering of the gas condensate residues. A small section of coastal waters west of Port Campbell is predicted to be exposed low to high (effect level) entrained phase hydrocarbons and low-moderate dissolved phase hydrocarbons. The section of coastline predicted to be contacted contains patchy subtidal rocky reef, where it is likely that macro-algal communities exist. It is possible that within the condensate spill EMBA, areas of higher dissolved and entrained phase may lead to localised areas of impact (expected to be sub-lethal based upon concentrations/observations) for a very short period of time. Hydrocarbons are likely to weather rapidly with high-energy waves against the sheer cliffs breaking up hydrocarbons along the coast. From literature affected macroalgae regenerates quickly and any localised mortality of macro-algae is likely to lead to rapid recruitment from nearby seed stock (minor consequence).	

General sensitivity to oiling – coastal saltmarsh communities (high sensitivity rating)
Saltmarsh is present in areas with some type of connectivity to saline tidal influences (surface or groundwater) and are located in the upper inter-tidal environment.

Oil can adhere readily to saltmarsh and recovery times are variable depending upon the level of impact. Saltmarsh areas are typically nursery areas for fish and invertebrate species and typically consist of fine grain often anoxic sediments held in place by the rhizomes of the plant. Damage and dieback of the plants often causes erosion of the habitat as a whole (Hook et al, 2016). Damage to saltmarsh is usually most severe in the areas closest to the shoreline. It was observed as a result of the Deepwater Horizon oil spill, oiling and plant stress where both highest within 14m of tidally inundated areas (Hook et al, 2016). For temperate species there is seasonal die-back, and during spring and summer (growing season) the species are more susceptible to oil impacts (IPIECA, 1994). Impacts are related to oil toxicity (lighter, non-weathered products causing more impacts such as MDO) or smothering (physical effect). Oil loading also determines recovery times. For light to moderate oiling with little penetration into the sediments, the plant may be killed in part, but recovery can take place from the underground systems – generally good recovery in 1-2years. Oiling of shoots with substantial penetration into the sediments with damage to underground systems may delay recovery (~7years). With thick deposits of oil, vegetation is likely to be killed by smothering and the recovery period for species can be significant (~20years) (IPIECA, 1994). Shoreline loadings of more than 1,000 g/m^2 of oil during the growing season would be required to impact marsh plants according to observations by Lin and Mendelssohn (1996). Similar thresholds have been found in studies assessing oil impacts on mangroves. Thus 1000 g/m^2 is representative of higher level ecological impacts (i.e. ecosystem based impacts).
Potential impacts from this project
Shoreline
Areas of saltmarsh within the CHN operational EMBA vary in their connectivity with the sea and their elevation above sea level which affects their risk of being affected by a condensate spill. The condensate entrained phase EMBA extends from Mepunga (30 km northwest of the HDD site) to Wattle Hill (30 km southeast of the HDD site). This geographic area covers inlets between Curdies Inlet and the Gellibrand River. Within this coastal area the only inlet identified in literature as containing saltmarsh is Port Campbell Creek. From literature, this saltmarsh is associated with an inland wetland and lies at elevations of at least 6masl. Tidal inundation during a spill event would not be expected to reach this vegetation given the tidal variation which occurs on the Otway coastline (~2m (max)). Accordingly, given the elevation of this saltmarsh and in periods of tidal ingress should the creek be open to the sea, it is not expected that hydrocarbons would impact upon this saltmarsh herb-land. Maximum shoreline loadings predicted for a pipeline rupture at the HDD are 153.6 g/m^2 (below impact threshold).

General sensitivity to oiling – commercial fishing (medium sensitivity rating)

Commercial fishing has the potential to be impacted through exclusion zones associated with the spill, the spill response and subsequent reduction in fishing effort. Exclusion zones may impede access to commercial fishing areas, for a short period of time, and nets and lines may become oiled. The impacts to commercial fishing from a public perception perspective however, may be much more significant and longer term than the spill itself.

Fishing areas may be closed for fishing for shorter or longer periods because of the risks of the catch being tainted by oil. Concentrations of petroleum contaminants in fish and crustacean (i.e. lobster) and mollusc tissues (e.g. abalone) could pose a significant potential for adverse human health effects, and until these products from nearshore fisheries have been cleared by the health authorities, they could be restricted for sale and human consumption. Indirectly, the fisheries sector will suffer a heavy loss if consumers are either stopped from using or unwilling to buy fish and shellfish from the region affected by the spill. Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm.

The Montara spill (as the most recent [2009] example of a large hydrocarbon spill in Australian waters) occurred over an area fished by the Northern Demersal Scalefish Fishery (PTTEP, 2013). As a precautionary measure, the WA DoF advised the commercial fishing fleet to avoid fishing in oil-affected waters. Testing of fish caught in areas of visible oil slick (November 2009) found that there were no detectable petroleum hydrocarbons in fish muscle samples, suggesting fish were safe for human consumption. In the short-term, fish had metabolised petroleum hydrocarbons. Limited ill effects were detected in a small number of individual fish only (PTTEP, 2013). No consistent effects of exposure on fish health could be detected within two weeks following the end of the well release. Follow up sampling in areas affected by the spill during 2010 and 2011 (PTTEP, 2013) found negligible ongoing environmental impacts from the spill.

In the event of a spill, a temporary fisheries closure may be put in place by Fisheries Victoria (or voluntarily by the fishers themselves). Oil may foul the hulls of fishing vessels and associated equipment, such as gill nets. A temporary (short- or long-term) fisheries closure, combined with oil tainting of target species (actual or perceived), would lead to financial losses to fisheries and economic losses for individual licence holders. Fisheries closures and the flow on losses from the lack of income derived from these fisheries are likely to have short-term but widespread socio-economic consequences, such as reduced employment (in fisheries service industries, such as tackle and bait supplies, fuel, marine mechanical services, accommodation and so forth).

Potential impacts from this project

Surface oiling	Water column	Shoreline
<u>Finfish (snapper, wrasse)</u> Not applicable.	Direct impact on this fishery is not considered to be significant due to the large spatial extent of the fishery itself and the localised zone of low exposure entrained hydrocarbons from offshore condensate spills and the limited area of hydrocarbon exposure from a pipeline rupture at the HDD site. As per pelagic fish section, while not expected tainting from hydrocarbon residues may be possible (minor consequence).	Vessels used in this fishery are not likely to use local ports.
<u>Abalone</u> Not applicable	The condensate EMBA intersects an abalone habitat at Warrnambool Reef located 30 km to the NW of the HDD site. Effects at this location are limited to low-level entrained hydrocarbons. This exposure is not expected to cause any lethal or sub-lethal impacts given the low-level effects concentration (negligible consequence).	No impacts predicted.
<u>Rock lobster</u> There is potential for lobster pot buoys to accumulate hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	Nearshore areas fished for rock lobster are predicted to have low to high exposure to entrained condensate. A short-term exclusion of fishing in this area is unlikely to have a significant impact on this fishery given the abundance of similar habitat along the Otway coastline outside the condensate spill EMBA. While impacts to the fishery as a whole are unlikely, impacts to individual fishers working the affected may be significant if actively fishing at the time of a spill. Localised tainting may be an issued with commercial fisheries in this area (minor consequence). This impact would be temporary and recoverable (~months).	Vessels used in this fishery use local ports. However, hydrocarbon coating of vessel hulls and jetty or port infrastructure is highly unlikely.

General sensitivity to oiling – tourism (medium sensitivity rating)

During an oil spill event, not only are tourist destinations affected directly in areas where the spill has impacted upon the coastline, but it also faces significant reputational impacts, particularly in those areas which are considered to be 'unspoilt' by development. Public perception strongly influences people's decisions whether to visit a destination.

For the Deep-water Horizon spill, which was a significantly larger oil spill with significantly higher spill impacts when compared with a gas condensate release from the CHN assets, a study commissioned by the Louisiana Office of Tourism two months after the Deepwater Horizon spill incident found (CRED, 2017):

- The spill had a negative impact on people's intentions to visit Louisiana. People who had previously intended to visit the state had postponed or cancelled their trips;
- Perception overshadowed actual impacts: a quarter of people thought that leisure activities (swamp tours, boating and hiking) were closed when in fact this was not the case;
- The seafood industry was particularly impacted by perceptions: for example, over half of people surveyed thought that Louisiana oysters were unsafe to eat although evidence demonstrated otherwise.

This resulted in significant impacts on the hospitality sector and small businesses.

Potential impacts from this project		
Surface oiling	Water column	Shoreline
In the event of a significant spill event from the CHN assets, it is possible that some impacts on tourism perception may reduce numbers visiting the Shipwreck coastline. However, impacts associated with a spill event would be limited in scale, very localised in impact and temporary in nature. CHN condensate released does not have a significant surface presence (i.e. low sheens except for a HDD pipeline rupture which is temporary and localised). In addition, visitation to the Twelve Apostles is for its aesthetics and scenery, two aspects which are not expected to be significantly affected by a limited release condensate spill. The impact to visitation is expected to be small on this basis. Releases from offshore facilities (e.g. pipeline rupture at PLEM and well blowout) are not expected to be visible from the shoreline. In the event of a spill, it is expected that state media exposure is possible. On a business reputation basis, this impact is assessed as a moderate consequence.		

Likelihood of LOC:

The integrity of a submarine pipeline system is ensured through all phases of life, from initial concept through to final decommissioning. There are two primary processes to achieving this:

1. Establish integrity in the concept development, design and construction phases; and
2. Maintain integrity in the operations phase.

During concept development, design and construction, integrity is established by: anticipating normal and abnormal loads to the pipeline system and proving, by calculation, the system can withstand these loads with factors of safety i.e. redundancy; verifying that the concept development and design are adequate through third party validation programs; ensuring that the materials specified by the design are delivered with the required quality e.g. pipe materials are as strong as the values used in the design calculations; ensuring that construction techniques, particularly welding, are executed with sufficient quality to maintain the design requirements for the pipeline once installed; carrying out a system pressure test to a pressure over, and above, the maximum allowable pressure of the pipeline to prove the pipeline is capable of its design intent.

During operation of the pipeline, monitoring and inspection are routinely carried out to ensure the quality of the design is maintained to ensure it remains able to withstand the normal and accidental loads anticipated. Where the design is found to be deteriorating, then corrective action is taken to maintain the design resistance to the normal and abnormal loads.

Given this philosophy to integrity and the maturity of offshore pipeline engineering and integrity management, any deterioration of the pipeline will likely to be slow and gradual and most likely detected during routine monitoring and / or inspection. Severe and / or rapid deterioration of the pipeline would indicate that the concept development, design, construction, operation and maintenance have been inadequate, which is unlikely, or alternatively external influences have changed in an extreme manner that was never anticipated, which is again unlikely. It is therefore considered reasonable that LOC incidents are more likely to be relatively low volume leaks than high volume ruptures. Given the implementation of the CHN IMP, LOC incidents are considered remote.

6.21.4 Environmental Impact and Control Measure Summary

Aspect:	Condensate Loss of Containment
Impact summary	Marine pollution, potentially leading to injury or death of marine fauna or seabirds through ingestion or absorption.
Extent of impact	Localised.
Duration of impact	Temporary (rapid dispersion and dilution – ranges from minutes to weeks (wellhead)).
Level of certainty of impact	HIGH. All parameters provided for spill modelling have been conservatively estimated to provide the largest credible spill footprint. Conservative thresholds have also been utilised to define this footprint. Modelling parameters are also conservative on the following basis: • Models used are best practice and industry standard conforming to quality standards (ASTM Standard F267-07); • Modelled tides and currents have been validated against actual tides and currents; • Weathering characteristics of condensate have been based upon scientific studies and the degree of confidence is high; • Sample size has been studied by RPS-APASA and shown that variation can occur between 50 and 100 simulation runs however the variation between 100 and 200 simulations results in minimal variation.
Impact decision framework context	B. The activity is a standard operation and 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 spills to the marine environment include:

- *Navigational Requirements:* CHN wellheads and pipeline are marked on navigation charts.
- *Integrity and Maintenance of Assets:* Pipeline and well operations/maintenance are undertaken in accordance with operating guidelines and integrity management plans.
- *Field entry control:* A Field Entry Permit is completed and approved prior to vessels entering the CHN wellhead PSZ.
- *Field activity controls:* Offshore activities are undertaken in accordance with a campaign-specific risk assessment, approved work procedures and a PTW which incorporates relevant environmental controls.
- *Well Monitoring*: Pressure and temperature of the producing well subsea trees is monitored daily.
- *Subsea tree valves and leak-off testing*: Subsea tree valves are function and leak-tested at routine intervals.
- *Spill Source Control (pipeline):*
    - Overpressure alarms are responded to immediately in accordance with approved operating procedures.
    - Low-pressure trips are responded to immediately in accordance with the Casino Master Control System (MCS) and Alarm Management Procedure.
    - The pipeline low-pressure trip is routinely tested.
- *Spill Response Preparedness:*
    - The Iona Gas Plant Emergency Response Team (ERT) is trained to respond to process alarms and to notify Cooper of any spill events.
    - Routine drills test oil spill response arrangements.
    - Approved emergency and oil spill response documentation is readily available to Cooper Energy personnel.
- *Spill Response (Implementation):* In the event of a spill:
    - The approved Emergency Response Plans (including the Cooper OPEP) are implemented
    - For wellhead releases the Cooper Offshore Victoria Source Control Plan is implemented.
    - Operational and scientific monitoring is undertaken in accordance with the Cooper Operational and Scientific Monitoring Program (OSMP) to reduce impacts to the environment.

6.22 Risk: Diesel spill (Vessel)

6.22.1 Hazard

The following activities have the potential to results in a spill of marine diesel oil (MDO):

- A collision between the support vessel and a third-party vessel that results in diesel tank rupture and MDO loss;
- Vessel grounding of smaller IMR vessels nearshore as a result of loss of power (i.e. drift grounding).

Given the close proximity to ports, it is not planned to undertake refuelling activities on location, so refuelling spills have not been considered or modelled.

There are no emergent features along the CHN assets (rocky near-shore areas had pipeline installed by HDD and therefore have no need to be visited by vessels), so vessel grounding of larger marine support vessels for activities around wellheads as a causal pathway has been ruled out as a credible risk. DNV (2011) identifies that the risk of powered grounding within 4 nm of the shoreline or emergent system is negligible.

DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m^3) for offshore vessels caused by collisions or fuel transfers.

MDO fate and weathering characteristics:

A spill volume of 160 m^3 of marine diesel oil (MDO) has been modelled for the CHN assets as the largest MDO spill risk. The specifications of the MDO used for the OSTM are presented in Table 6-5. MDO classified as a Group II oil (persistent).

Table 6-5: Boiling Ranges and physical characteristics of MDO

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

MDO is dominated by n-alkane hydrocarbons and usually consist of carbon chain C_{11}-C_{28} but may vary depending upon specifications (e.g., winter vs. summer grades). While MDO is generally considered to be a non-persistent oil, many can contain a small percentage (approximately 3-7%) by volume of hydrocarbons that are classified as 'persistent' under IOPC Fund definition (i.e., greater than 5% boiling above 370°C). While the majority of the MDO will quickly evaporate, it is common for the residues of diesel spills after weathering to contain n-alkanes, iso-alkanes and naphthenic hydrocarbons. Minor quantities of PAHs will be present.

When spilt at sea, MDOs will spread and thin out quickly and more than half of the volume can be lost by evaporation within 12 hours depending upon sea temperature and winds. MDO also has low viscosity and can result in hydrocarbons becoming physically dispersed as fine droplets into the water column when winds exceed 10 knots. Natural dispersion of MDO will reduce the hydrocarbons available to evaporate into the air.

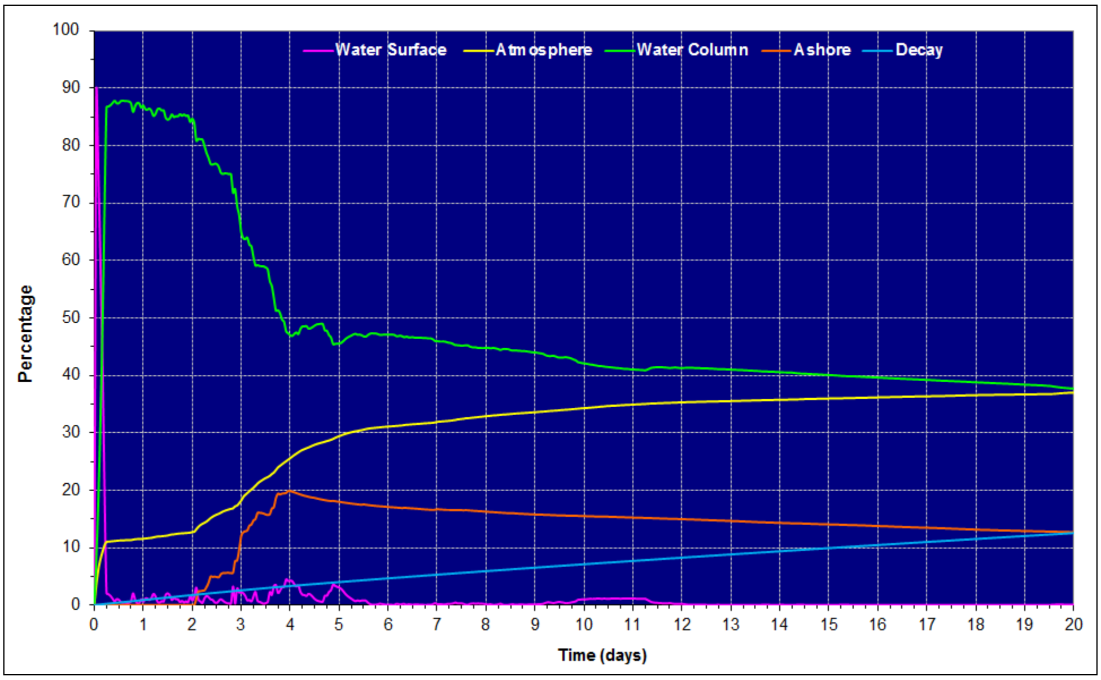
The different MDO product compositions, together with different environmental conditions during marine spills (sea temperature, wind and sea states) can vary the quantities of hydrocarbons lost to the atmosphere due to evaporation (but generally ranges between 40-65%). Dispersion into the sea by the action of wind and waves can result in 25 to 50% of the loss of hydrocarbons from surface slicks and dissolution (solubility of hydrocarbons) can account for 1-10% loss from the surface.

Due to their higher solubility and ease of entrainment/dispersion into the water column, MDO spills can have a greater ecological impact in comparison to other floating oil slicks. MDOs are also known to taint seafood. According to the International Maritime Organisation (IMO), diesel oil has a GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) rating of 3 for acute toxicity (damage to living organisms) and 4 for bioaccumulation/tainting (4 = high potential to bio-accumulate, 5 is the highest).

MDO in the water column can adhere to fine-grained suspended sediments that can settle out and result in oiled sediments being deposited on the seabed. MDO spills that reach shorelines are usually still mobile residues and will penetrate shoreline sediments due to the low viscosity of the oil and have direct consequences on in-faunal organisms.

The fate and weathering graph for a single 160 m^3 MDO spill trajectory (refer Figure 6-2), considered the worst case spill from a shoreline residue perspective, demonstrates the likelihood of MDO to entrain under moderate winds and potentially remain sub-surface for extended periods, where it is subjected to degradation (or decay) processes only. In this particular case, the modelling showed that the hydrocarbons could potentially resurface days later far from the original release site. The ongoing rate of surface oil weathering is dependent on wind conditions.

Figure 6-2: Predicted weathering and fates graph, as a function of percentage, for a selected single MDO spill trajectory



Oil Spill Modelling Results:

Thresholds utilised to assess oil spill impacts for MDO spills are provided in Table 6-2. Oil spill modelling results for the 160 m3 MDO spill at the PLEM location (deeper water) is provided in Table 6-6.

It is noted that the smaller IMR vessels, which have a smaller spill risk, may operate in near-shore areas around the HDD location (i.e. approx. 800 m from shore). ADIOS modelling (NOAA, 2017) for a 12m^3 oil spill at 15^{o}C water temperature predicts the following:

- At wind speeds of 5 knots after 24 hrs approximately 55% of the spill remains on the sea surface (6.6 m^3) with approximately 45% evaporated;
- At wind speeds of 15 knots, 23% of the volume has evaporated after four hours is approximately 23%, 70% of the spill volume has become entrained in the water column and 7% remains at the sea-surface (0.84m^3).

Based upon MDO results for larger spills, the spill trajectories are influenced by the north-west/south-east currents in the region and the prevailing wind direction, noting that the average wind speed at Cape Otway is approximately 25 km/hr (13.5 knots) (BOM, 2017). If a spill occurred in shallower waters given the predominant south-westerly swell direction, there are minimal longshore currents and water movements are predominantly influenced by wave action and localised wave-generated currents. As observed in condensate releases at the HDD site, the shoreline areas adjacent to the release site are the areas primarily affected by spill impacts. Given the small volumes of MDO utilised in IMR vessels, MDO spill impacts from a nearshore spill would be expected to affect adjacent shoreline areas between the Arch and Port Campbell before being diluted and dissipated.

For spills along the pipeline alignment but at greater distances from shore, semi-diurnal currents will prevail. Given the small spill volume it is expected that the spill residue may travel in prevailing current direction before current reversal with dissipation and dispersal below thresholds levels after this time. On this basis the maximum excursion, assuming the maximum current speed for the entire 6 hours would be 10.8 km to the north-west and 19.5 km to the south east.

Table 6-6: MDO Oil Spill Modelling Results

Scenario	Results	
Surface water	**Sea surface exposure**	**Shoreline exposure**
1 g/m^2 (low exposure)	Travelled a maximum of 36 km, favouring the northwest direction. 0-5% chance of scattered exposure to Twelve Apostles Marine National Park.	A 22% probability of shoreline exposure, taking a minimum of 11.5 hours. A maximum volume of 66 m^3 of MDO stranding ashore.
10-25 g/m^2 (moderate exposure)	Travelled a maximum of 18 km, favouring the west-northwest direction. No exposure to marine parks.	0-16% probability of shoreline exposure, from west of Portland to Anglesea, with the majority of contact probability being in the 0-5% range. MDO would travel through the Twelve Apostles Marine National Park.
>25 g/m^2 (high exposure)	Travelled a maximum of 11 km, favouring the northwest direction. No exposure to marine parks.	Maximum 13% probability of shoreline exposure.
Dissolved phase		
576-4,800 ppb.hrs (low exposure)	No exposure of any meaningful level.	
4,800-38,400 ppb.hrs (moderate exposure)	No exposure of any meaningful level.	
>38,400 ppb.hrs (high exposure)	No exposure of any meaningful level.	
Entrained phase		
672 ppb.hrs (low exposure)	This zone extends to waters up to 100 km west-northwest and approximately186 km to the east.	
6,768 ppb.hrs (moderate exposure)	Exposure was scarce and isolated.	
77,088 ppb.hrs (high exposure)	No exposure of any meaningful level.	

Scenario	Results	
Surface water	Sea surface exposure	Shoreline exposure
Shoreline		
LOW EXPOSURE: 10-100g/m^2	The affected area is predicted to stretch between Cape Bridgewater and Anglesea at very low probabilities of exposure (0-10%). The areas with the highest probability of exposure at these levels are between Port Fairy and Cape Otway.	
MODERATE EXPOSURE: 100-1000g/m^2	This area lies again from Port Fairy to Cape Otway. As per low level exposure the probability of this exposure is very low.	
HIGH EXPOSURE: >1000g/m^2	These isolated areas lie from Peterborough to Warrnambool and at Cape Otway. As per low level exposure the probability of this exposure is very low.	

6.22.2 Known and Potential Impacts

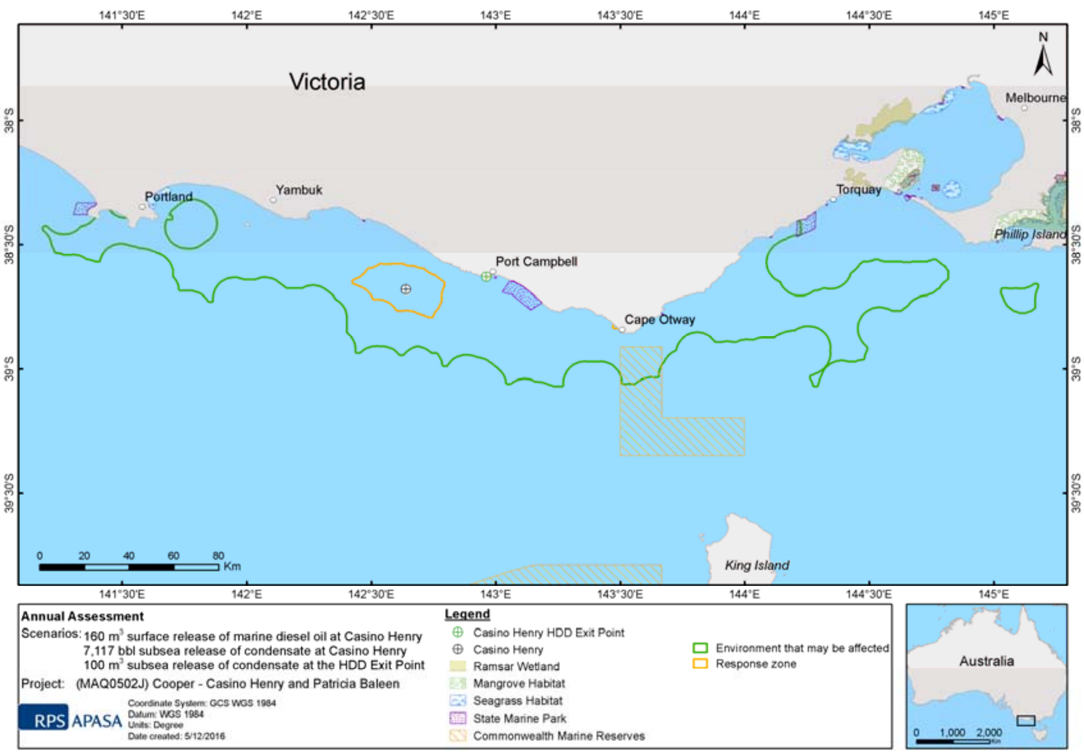
The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality; and
- Injury or death of marine fauna and seabirds exposed to the MDO.

The EMBA for a 160 m^3 MDO spill based upon oil spill modelling predicts a 160 m^3 spill of MDO may on a surface sheen basis travel up to 36 km, favouring the northwest direction. Figure 6-3 provides the EMBA defined by the entrained phase boundary which incorporates surface sheens.

A MDO spill may occur in both Victorian state and Commonwealth waters.

Figure 6-3: Predicted 160 m^3 MDO EMBA



Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic and demersal fish;
- Benthic species;
- Marine mammals (cetaceans and pinnipeds);
- Seabirds and shorebirds;
- Commercial fishing; and
- Tourism.

Habitat that may occur within this EMBA where these species may be present includes:

- Sandy beaches;
- Rocky shoreline;
- Submerged shelf rocky reefs and hard substrates;
- Macro-algal and seagrass beds;
- Saltmarsh; and
- Open water.

Protected areas or features that occur within the EMBA are:

- The Arches Marine Sanctuary;
- The Twelve Apostles Marine National Parks;
- The Port Campbell National Park;
- The Bay of Islands Coastal Park;
- Merri Marine Sanctuary;
- Marengo Reef Marine Sanctuary;
- Eagle Rock Marine Sanctuary;
- Apollo CMR;
- Sub-tropical and Temperate saltmarsh; and
- Giant Kelp Marine Forests of SE Australia TEC.

6.22.3 Evaluation of Environmental Risk

The impacts of MDO to habitats and wildlife are similar to those described for gas condensate spills in Section 6.21. This is due to their common lighter-end components which rapidly evaporate and minor heavier end components which have a low viscosity allowing for rapid spreading and permeability into sediments at shorelines. Specific literature separating gas condensate and refined hydrocarbons such as diesel is sparse, with most impacts related to the physical components of the hydrocarbon released. As such, this section does not discuss the general impacts of MDO spills on individual receptors (refer to Table 6-4 for this information). This section assesses the implications of the MDO spill for this activity as outlined in Table 6-7.

Table 6-7: Assessment of a 160m^3 MDO spill from the CHN assets

Receptor	Sea surface	In-water	Shoreline
Benthic assemblages	Not applicable.	Modelling predicts temporary patches of entrained MDO may be present through the EMBA at 0-20 m water depth. Impact by direct contact of benthic species with hydrocarbon in the deeper areas of the release area is not expected given the surface release and the water depth at the spill location. Species closer to shore may be affected although these effects will be localised, low level and temporary, noting that in-water thresholds selected for interpretation are effects levels for 95-99% species protection . Note that inshore MDO spills (~12m^3) are smaller in nature and will have very localised and temporary impacts. Filter-feeding benthic invertebrates such as sponges, bryozoans, abalone and hydroids may be exposed to sub-lethal impacts however population level impacts are considered unlikely. Tissue taint may occur and remain for several months in some species (e.g., lobster, abalone) however, this will be localised, low level and recoverable (negligible consequence).	There is a 22% probability of shoreline exposure above thresholds along the Port Fairy to Cape Otway coast line from a significant offshore MDO spill. The maximum volume ashore is 65.9 m^3 and average is 26.9 m^3 of MDO. Nearer to shore activities undertaken with smaller vessels (~12m^3 spill risk) have a smaller spill risk. Due to the low viscosity of the MDO residue after a spill, studies indicate it is likely to percolate into the voids between sand particles not as a surface residue. Inshore and intertidal benthic species may be exposed to weathered MDO (minimum time to shore is 11.5 hours from offshore spill) and smaller volumes but fresher hydrocarbon from near shore spills. Inshore reefs occur along this section of coastline, so it is also likely that that those communities would be exposed but to low level entrained hydrocarbons (95% species protection). Resident shoreline fauna such as worms, molluscs and crustaceans may suffer lethal impacts if MDO penetrates into sediments (unlikely given the limited sheltered shorelines containing sand along the coast). If this occurred, it would be in isolated areas and recolonization by adjacent species would occur in the short to medium term (negligible consequence).
Plankton and Planktonic eggs	Plankton (including planktonic eggs and larvae) found in open waters of the EMBA is expected to be widely represented within waters of the wider Bass Strait region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by entrained hydrocarbons. Entrained phase MDO may intersect the Bonney Upwelling KEF around the Port Fairy to Portland area. While a spill would not affect the upwelling itself, if the spill occurs at the time of an upwelling event, it may result in krill being exposed to low (effects) level entrained phase MDO (99% species protection). Pygmy blue whales feeding on this krill may suffer from reduced prey however these impacts are expected to be extremely localised and temporary. Once background water quality conditions are re-established, plankton populations are expected to recover due to the recruitment of plankton (& planktonic eggs) from surrounding waters. The overall impact of hydrocarbon spills on plankton is not considered to be significant in the long-term (negligible consequence).		Not applicable.

Receptor	Sea surface	In-water	Shoreline
Fish	The majority of adult fish, including sharks, tend to remain in the mid-pelagic zone and are not likely to come into contact with surface hydrocarbons. It is possible that some near-shore species (e.g. some syngnathid species) associated with nearshore rocky reefs and rafts of floating seaweed may come into contact with surface oil if present through entrainment, however given the dynamic nature around near-shore reefs exposure is not considered to be significant. Any impacts from surface oiling on fish are considered to be negligible at a population level.	Ingestion of hydrocarbons in the water column is possible for adults and juveniles in the mid-pelagic zone, however generally these species are highly mobile and as such are not likely to suffer extended exposure. Hook et al (2016) states that high concentrations of dissolved hydrocarbons are required to cause outright fish mortality. MDO rapidly loses its lighter more toxic components (BTEX) when spilt as identified in modelling where there is not an appreciable dissolved phase exposure. In-water entrained concentrations are predicted to be low to moderate exposures (the latter with low probability) which are localised and will be rapidly diluted. Fish mortality is not expected through these exposures and sub-lethal effects are not expected as fish are highly mobile and unlikely to remain in the entrained phase plume for the days required to exhibit these outcomes. For benthic or site attached fish within the shallower areas exposed to low-moderate effects levels of entrained hydrocarbons, areas affected will be localised and significant impacts at a population level would not be expected. Large scale population level impacts on fish species, abundances or assemblages from an MDO spill at the CHN assets, given the wide geographical distribution of many fish in Bass Strait is unlikely and impacts are considered negligible.	Not applicable.

Receptor	Sea surface	In-water	Shoreline
Cetaceans	Modelling predicts exposure zones of surface hydrocarbons from a significant offshore MDO spill are very localized and do not overlap the nearby aggregation BIA for southern right whales (though the nearshore migration BIA may be overlapped). A surface slick may overlap the foraging BIA for the pygmy blue whale. Zooplankton is able to ingest hydrocarbon particles and rapidly process them (Volkman *et al*., 1994), so if large quantities of affected prey were ingested, chronic toxicity impacts to pygmy blue whales may occur. Biological consequences of physical contact with very localised areas of low concentration hydrocarbons present at the sea surface for approximately 24 hours are unlikely to lead to any long-term impacts, with temporary skin irritation and very light fouling/matting of baleen plates possible if present (minor consequence). Population level effects on cetacean species present are considered unlikely.	The zones of potential entrained MDO overlaps with the nearshore migration BIA for southern right whales and aggregation areas at Port Fairy and Logan's Beach. This effect-level exposure (95-99% species protection) is unlikely to affect aggregating whales given they are not normally foraging at this time. Sub-lethal impacts (temporary skin irritation, etc.) might be experienced, however exposures will be short-term and expected to be recoverable. Cetaceans migrating through these zones, especially southern right whales during their predicted nearshore migration (mid-May to mid-July and September to mid-November), may ingest contaminated water and plankton. The biological consequences of physical contact with low effect level concentrations of hydrocarbons in the water column over several days may lead to some short-term impacts, with temporary skin irritation being the most likely impact. Population level effects on migrating, feeding or aggregating whales (and other species that may be present) are considered unlikely.	Not applicable.

Receptor	Sea surface	In-water	Shoreline
Pinnipeds	Localised parts of the foraging range for New Zealand and Australian fur-seals may be temporarily exposed to low to high concentrations (up to 25 g/m^2) of MDO at the sea surface for very short periods (up to 24 hours) at the spill location. Exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. The extent that this results in permanent injury or mortality is unknown, but given the absence of breeding colonies and haul-out sites within the area of this surface oil, population level impacts would not be expected. Individual animals may be exposed to these high surface loadings which may cause injuries and mortality as they transit the area but this is not expected to lead to population level impacts.	Localised parts of the foraging range for New Zealand and Australian fur-seals may be temporarily exposed to low concentrations of entrained MDO in the water column (no dissolved phase). Small colonies of New Zealand and Australian fur-seals occur at Cape Nelson (low-moderate entrained phase exposure); Lawrence Rocks (low level exposure); Moonlight Head/Cape Volney (low-moderate entrained phase exposure) and Marengo Reef (low level exposures). Exposure to low/moderate exosure level hydrocarbons in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds, however given the temporary and localised nature of the spill, their widespread nature, the low level exposure zones and rapid loss of the volatile components of MDO in choppy and windy seas (such as that of the EMBA), impacts at a population level are considered very unlikely.	Predictive modelling indicates no shoreline stranding of hydrocarbons at Julia Percy Island or Lawrence Rocks. Low level of shoreline accumulation (>100g/m^2) is possible at Moonlight Head and Cape Volney where colonies are present. Given the rocky nature of haul-out sites, the MDO will rapidly weather through repeated wave action against the rocks. As such, oiling of individuals or group of pinnipeds (and impacts associated with this) is not expected. Impacts to pinnipeds are considered small (negligible impact).
Marine reptiles	As per the observations made for condensate and cetaceans, marine reptiles encountering hydrocarbon may result in skin or other cavity irritation. However, due to the sparse nature of turtles within the Otway Basin, potential impacts to marine reptile populations are considered to be unlikely.	The sparse population of marine reptiles in the EMBA combined with the localised extent of MDO exposure indicates that potential impacts to marine reptile populations from hydrocarbons in the water column are considered to be negligible.	There are no known turtle nesting beaches within the EMBA, so impacts to turtles from shoreline oiling will not occur.

Seabirds and shorebirds	When first released, the MDO has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. out to 18 km for a significant offshore MDO spill) may suffer impacts however it is unlikely that a large number of birds will be affected. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with localised areas of sheen >10µm and may experience lethal surface thresholds, however the area of contact is localised and temporary (~24hrs). Contact with areas of high hydrocarbon exposure is highly unlikely. As such, acute or chronic toxicity impacts (death or long-term poor health) to small numbers of birds are possible, however this is not considered significant at a population level. The OSTM indicates that surface hydrocarbons are unlikely to enter the Curdies Inlet at Peterborough (which in any case is rarely open to the sea), thus limiting the potential impacts to wetland bird species in the area (i.e. Curdies Inlet is the only recognised estuary for shorebirds in the areas affected by surface oil).	Impacts from hydrocarbons to birds in the water column are unlikely without the bird first being exposed to surface oil. This exposure route is not considered as significant as direct contact with hydrocarbons on the sea surface or at the shoreline. Penguin colonies feeding in the area may be exposed to localised areas of low – medium (effects level) exposures of entrained hydrocarbons (there is no meaningful level of dissolved MDO predicted by the OSTM), which may cause sub-lethal impacts. Entrained phase hydrocarbon exposure in these areas is not expected to impact on their prey stock. Given the species is wide ranging in foraging habitats and their nightly return to burrows at the shore, they are unlikely to remain within plumes of entrained MDO (i.e. very mobile). This is not expected to cause toxicity effects, however preening once onshore may increase sub-lethal exposures.	Small isolated sections of sandy shoreline between Cape Otway and Port Fairy that have a low probability of MDO stranding at concentrations of >100 g/m^2. Other sections potentially affected such as intertidal platforms/rocky coastlines are not expected to accumulate hydrocarbon due to wave and tidal action. Locations which are identified along the areas which could be affected by shoreline resides in excess of 100 g/m^2 are: • Penguins (Middle Island – Warrnambool; Murmaine Bay- Flaxman Hill coastline; Bay of Islands; London Bridge; The Twelve Apostles); • Hooded Plover (Nurmaine Bay to Flaxman Hill; Crofts Bay; Curdies Inlet; Shelly Beach; Lochard Gorge; Clifton Beach; Johanna Beach; Aire River; Station Beach). Impacts to penguins are likely to be similar to those described for condensate. Any coating of feathers may be preened once onshore, which would increase oil ingestion and may lead to acute or chronic toxicity depending on the amount ingested and the life stage of the bird. If shorebirds have a long duration of exposure to areas of heavy shoreline oiling (or long duration of ingestion of weathered oil), it is possible that lethal impacts may occur. However, this is extremely unlikely given the characteristics of MDO and its residues which, due to their viscosity, percolate into sand (hence limited potential for direct oiling). For shoreline areas which are inter-tidal platforms/rocky shorelines, accumulation will be temporary given wave and tidal action which remobilises and weathers MDO residues. Populations of most shorebird species within the EMBA (including plovers, penguins, terns and sandpipers) also have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other locations. Population level impacts due to shoreline residue accumulation are considered unlikely. Shorebirds foraging for food in intertidal sand areas may experience secondary impacts due to MDO residues impacting invertebrate prey. Tidal washing within sand environments rapidly degrades MDO residues allowing for rapid recolonization by adjacent invertebrate species. Areas affected will also be isolated in nature. These localised impacts would not be expected to affect shoreline bird species at a population level.

Receptor	Sea surface	In-water	Shoreline
Sandy beaches	Not applicable.	Not applicable.	Small isolated sections of sandy beaches between Cape Otway and Port Fairy are predicted to have a low probability of MDO residue stranding at concentrations of >100 g/m^2. These include (excluding mixed platform/sand environments) Port Fairy Bay, Logans Beach (Warrnambool), Crofts Bay, Curdies Inlet, Port Campbell, Lochard Gorge, Clifton Beach, Princetown Beach, Johanna Beach, Aire River Beach and Station Beach. Small sections of the coastline between Curdies Inlet and Mepunga have a low probability of shoreline residues >1000g/m^2. As per shoreline birds section, sandy beach environments are not likely to accumulate MDO residue due to the viscosity of the hydrocarbon. The constant wave action and tidal movements will naturally wash and degrade MDO residues which remain in the inter-tidal area. Beach environments rapidly rehabilitate and any residual shoreline residues should not create visual aesthetic impacts to visiting tourists. A threshold of 100 g/m^2 oil thickness is considered to be enough to coat animals living on or in the sand may impact survival and reproductive capacity. Based on this, areas of heavy oiling may result in acute toxicity, and death, of shoreline invertebrate communities, especially where oil penetrates into sediments through animal burrows. These communities would be expected to rapidly recover as oil is removed with the tides (sediment reworking). Given the MDO spill is localised, limited in volume and temporary, invertebrate impacts at a population level are not considered to be significant.
Rocky shores	Not applicable.	Not applicable.	Much of the coastline predicted to be contacted by an MDO spill comprises steep rocky cliffs. Impacts to the rocky shores of the EMBA should not vary significantly from those described for the condensate spill scenarios. The action of reflected waves off rocky shores means it is unlikely that toxicity or smothering effects to exposed invertebrates will occur on this type of shoreline. The oil is likely to be continually washed off the substrate and into the water, leading to further weathering. Given the MDO spill is localised and temporary, impacts to these areas are not considered to be significant.

Receptor	Sea surface	In-water	Shoreline
Macro-algal communities	Not applicable.	The Giant Kelp TEC is not known to be present in the entrained phase EMBA except at the Merri Marine Sanctuary which may be exposed to low-moderate effects level entrained hydrocarbons. It is possible that other areas of Giant Kelp Forests TEC may occur within the EMBA, however surveys undertaken in The Arches MS and Twelve Apostles NP have not identified any stands. Kelp dominated reefs to occur in the region and is noted as occurring around the Portland area with seagrass meadows also occurring along the Portland and Warrnambool coasts. These areas may be exposed to low concentrations of (effects level) entrained MDO, which are unlikely to result in significant impacts. Impacts to this community are likely to be similar to those described for condensate, noting that the rough seas of the nearshore environment will result in rapid weathering of the MDO residue.	
Saltmarsh	Surface sheens from MDO spills may extend from isolated areas around the Twelve Apostles National Park to Mepunga along the Otway coastline. Within that coastline segment, there are no areas of saltmarsh except a small area in Port Campbell Creek which is at elevations of 6masl and is not considered to be at threat from surface sheens.	In-water concentrations of low level effects-level entrained hydrocarbons (no aromatics) extend from Portland to Point Addis. Within that coastline there are a number of estuaries with saltmarsh lying within normal tidal ranges which may be exposed to these effects level concentrations. Invertebrates and fish nursery areas present in the salt marsh areas and exposed to these hydrocarbons may experience sub-lethal impacts, however impacts would be limited given the exposure from the hydrocarbons would be at a time when estuary mouths were open to tidal influence and there would be constant tidal flushing of these areas. Impacts are not expected to be significant to the saltmarsh plant or the species it protects.	Shoreline residues which exceed 1000g/m^2, and therefore may present a significant impact to saltmarsh growth rates are predicted between Curdies Inlet and Mepunga – a section of coastline which does not have areas of saltmarsh. Other estuaries between Port Fairy and Cape Otway may encounter residues of 100 g/m^2 however impacts would be sub-lethal and not expected to affect saltmarsh growth rates.

Receptor	Sea surface	In-water	Shoreline
Commercial fishing	Direct impact to finfish fisheries (snapper, wrasse) is not considered to be significant due to the large spatial extent of the fisheries and the localised zone of exposure to MDO at the sea surface. Given the commercial fishing equipment which is used in the EMBA, impacts associated with its contamination is assessed as a negligible consequence (<$5M) should it come into contact with surface oil (considered unlikely).	Direct impact to the finfish fisheries is not considered to be significant due to the large spatial extent of the fisheries and the localised zone of low exposure entrained hydrocarbons. Fisheries closures imposed at the time of a spill would limit fishing activity and may result in tainted fish (which are unsaleable). While tainting is considered possible from the MDO spill, entrained phase hydrocarbon levels in the environment are localised, at low levels and not considered sufficiently high to cause tainting (~ 250 ppb) to fish stock, particularly for mobile pelagic species. The exception to this is abalone and rock lobster found in inshore reef areas where isolated areas of moderate effects-level exposure of entrained phase MDO may occur. Exposures are localised and not considered sufficient to cause injury to the stock, but may cause tainting in these isolated areas. The value of the Victorian Abalone fishery in 2013 was $20M (SEWPC, 2013) and approximately 40% of the catch is taken from the Central region. Possible economic impact is assessed at $5-10M (moderate consequence).	Vessels used in local fisheries use local ports. However, hydrocarbon coating of vessel hulls and jetty or port infrastructure is highly unlikely.

Receptor	Sea surface	In-water	Shoreline
Tourism	Modelling predicts low level sheens (1-10 µm) may occur between The Twelve Apostles NP and Port Fairy, however these are mostly offshore. Shoreline sheens may occur between the western side of the Twelve Apostles NP and Mepunga during calm conditions. Such levels of hydrocarbon exposure, while not predicted to affect ecological integrity may trigger a localised stakeholder response to contamination of pristine environments and potential beach closures. Sheens close to the coast may be visible to tourists from coastal cliff lookouts, with offshore sheens visible to tourists undertaking helicopter joy flights. This may affect the visitor experience although the reason for visitation is coastline aesthetics and the scenery is unlikely to be significantly affected by temporary surface sheens. Minor impacts to tourist operators (such as helicopter and charter vessel operators) may result of this and attract state level media attention (moderate consequence based upon business reputation). Impacts to other tourist areas outside the sheen (Logan's Beach, Dinosaur Cove) are not expected.	Entrained phase MDO is not expected to be visible. Recreational divers may notice isolated areas of entrained MDO if it is coincident with dive sites such as shipwrecks.	Beached MDO does not tend to accumulate on sandy beaches and percolates into the sand due to its low viscosity. Visual amenity impacts, even if concentrations exceed 100 g/m^2 are predicted to be temporary and localised. Most of the tourist coastal viewing platforms are along coastal cliffs, where shoreline oiling is not likely to be visually evident. As such, tourists should not suffer a reduced visitor experience (negligible impact).

Impacts to matters of NES:

An MDO spill is not likely to have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of conservation significance:

Other areas of conservation significance within the EMBA affected by a MDO spill are outlined below. The discharge will not have any significant impact to other areas of conservation significance:

- The Bonney Upwelling KEF is within the EMBA for entrained MDO (top 10 m of water column). The upwelling is not affected by the spill however blue whales feeding on krill during an upwelling may ingest contaminated prey. Impacts to cetaceans are unlikely to be significant;
- The shelf rocky reef and hard substrate KEF may lie in the EMBA of MDO spills which occur in the deeper areas of the CHN assets (i.e. water depth > 60 m). The surface nature of the spill is unlikely to affect this KEF.
- Residue is unlikely to enter nationally important wetlands along the coast.
- State marine parks:
    - The Arches Marine Sanctuary may be within the EMBA for visible sheens (2.8 km east of pipeline).
    - The following marine sanctuaries may be affected by low levels entrained phase hydrocarbon:
        - The Twelve Apostles Marine National Parks;
        - The Port Campbell National Park;
        - The Bay of Islands Coastal Park;
        - Merri Marine Sanctuary;
        - Marengo Reef Marine Sanctuary;
        - Eagle Rock Marine Sanctuary.

Reserve values will not be impacted by the temporary and low level hydrocarbon exposures predicted.

6.22.4 Environmental Impacts and Control Measure Summary

Aspect:	Vessel MDO Loss of Containment (Fuel Tank)
Impact summary	Pollution of surface waters and/or shoreline. Injury or death of marine fauna and seabirds through ingestion or contact.
Extent of impact	Extends from Cape Bridgewater in the west to Anglesea in the east (based upon entrained phase concentration at 7ppb for 96hrs).
Duration of impact	Short-term and recoverable

Level of certainty of impact	HIGH. All parameters provided for spill modelling have been conservatively estimated to provide the largest credible spill footprint. Conservative thresholds have also been utilised to define this footprint. Modelling parameters are also conservative on the following basis: • Models used are best practice and industry standard conforming to quality standards (ASTM Standard F267-07); • Modelled tides and currents have been validated against actual tides and currents; • Weathering characteristics of MDO have been based upon scientific studies and the degree of confidence is high; • Sample size has been studied by RPS-APASA and shown that variation can occur between 50 and 100 simulation runs however the variation between 100 and 200 simulations results in minimal variation.
Impact decision framework context	B. The activity is a standard operation and 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 for this hazard should be read in conjunction with the prevention of displacement of third party vessels (refer Section 6.16).

Additional control measures to be implemented to eliminate or mitigate spills to the environment include:

- *Fuel Selection:* Fuel use on-board is marine diesel.
- *Refuelling:* No refuelling will be undertaken at sea (this will be done in port).
- *Vessel Selection:* The vessel selected for IMR activities will meet:
    - Class certification requirements under the Navigation Act 2012;
    - 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.
- *SMPEP Implementation:* Vessels have a current approved SMPEP (or equivalent appropriate to class) that is implemented in a spill event.
- *SMPEP Crew Induction*: Vessel crew members are inducted and trained into vessel spill response procedures.
- *Vessel SMPEP Exercises/Drills*: 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, the National Plan for Maritime Environmental Emergencies (NATPLAN) and Victorian Maritime Emergency (Non search and Rescue) Plan.
- *Spill Reporting*: Cooper will report the spill to regulatory authorities within 2 hours of becomes aware of the spill.
- *OPEP Implementation*: The Cooper Offshore Victoria OPEP is implemented in response to a spill during IMR activities;
- *Operational and Scientific Monitoring Plan (OSMP) Implementation*: Cooper will undertake operational and scientific monitoring in accordance with the Offshore Victorian OSMP.

7 Environmental Performance Monitoring

7.1 Implementation

Cooper manages the environmental impacts and risks associated with the CHN operational activity to ALARP and acceptable levels through the implementation of the Cooper Health, Safety, Environment and Community (HSEC) Management System (MS). The HSEC MS is a formal and consistent framework for all activities performed by Cooper and contracted resources.

This EP details a number of Environmental Performance Outcomes (EPOs) and Environmental Performance Standards (EPSs) for the activity. To achieve these performance outcomes, the EP's implementation strategy incorporates the following key HSEC MS 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, ongoing performance management, campaign-specific requirements);
- 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 organisation structure are allocated the responsibility for the implementation or compliance monitoring of EP commitments. All Cooper positions have position descriptions outlining their HSEC role, responsibilities, accountabilities and authorities and where relevant the specific competency requirements.

Lochard Energy, Cooper Energy's contract operator, operate the CHN pipeline facilities and wells on behalf of Cooper Energy from the Iona Gas Plant control room. The Iona Gas Plant is continuously manned—Production Technicians work a 12-hour shift on a two week on/off roster. Each shift comprises an Operations Shift Leader, a Responsible Officer and two additional operations personnel.

All contractors engaged on CHN operational activities undergo prequalification prior to contract award to ensure they have equivalent resource management systems to ensure personnel competencies and training and their procedures meet the requirements of this EP.

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 their specific responsibilities in the EP.

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

7.2.2 General

Cooper has a contractor management system that provides a systematic approach for the selection and management of contractors to ensure any third party has the appropriate management system and structures in place to achieve HSEC performance in accordance with Cooper's expectations. These requirements are contained within the Cooper Contractor and Supplier Management Standard Instruction.

The procedure applies to sub-contractors, Third Party Contractors (TPCs) and suppliers, attending, conducting work at Cooper sites or providing services for Cooper and its operations. It addresses operational HSEC performance of all contractors while undertaking project work under a Cooper contract, in an area of Cooper responsibility or covered under a Cooper HSEC MS. The key HSEC steps in the Cooper contractor management process include:

- Planning - HSEC assessment of potential contractors, suppliers and/or TPCs;
- Selection - Submission and review of contractors and/or TPC HSEC management data;
- Implementation - Onsite contractors and/or TPC HSEC requirements including induction and training requirements; and
- Monitoring, review and closeout - Ongoing review of contractors and/or TPC HSEC performance including evaluation at work handover.

Planning – Contractor Pre-qualification:

All contractors working directly under contract to Cooper must complete a contractor pre-qualification questionnaire to ensure minimum operational HSEC performance standards and equipment requirements are met. Key aspects of the pre-qualification process include:

- Project and/or workplace risk assessment relative to the risk of the work being undertaken by the contractor, in particular if work will be conducted simultaneously with other work; and
- HSEC assessment determined by Cooper Project Management and based on the nature of the work for which pre-qualification is being sought.

Note that exemptions apply in certain circumstances, and in these cases contractors must comply with the relevant Cooper HSEC Plan.

Contractors are selected based upon an assessment of their ability to:

- Comply with statutory requirements and Cooper standards;
- Have an acceptable HSEC performance record;
- Provide appropriate resources and competency in the services to be provided;
- The services and hardware comply with the requirements of the accepted EP; and
- Any equipment to be used meets regulatory requirements, is fit-for-purpose and meets Cooper standards (includes provision of all certificates, testing and verification of equipment).

Implementation and monitoring contractor performance:

As part of any work scope, Cooper reviews and approves contractor procedures to be utilised in asset activities. These procedures will be included in the work plan for the asset and monitored by the Cooper Offshore representative.

Cooper ensures that all works undertaken by contractors are aligned to Cooper's HSEC requirements which include adhering to environmental compliance items. Ongoing contractor performance against these requirements is monitored by both the contractor and Cooper.

7.2.3 Campaign-specific Vessel Compliance

Cooper, as part of contractor pre-qualification and selection, assess vessel compliance with the requirements of this Environment Plan. This covers aspects including, but not limited to:

- Vessel pollution control equipment;
- Assessment of IMS risk:
- Navigational safety (vessel lighting and navigation equipment);
- Crew competencies and training; and
- Emergency/spill response.

For vessels mobilising from international ports or ports outside the IMCRA Otway bioregion, as part of pre-qualification contractors will be required to undertake an IMS risk assessment[3] supplying relevant supporting documentation to Cooper to validate the IMS risk status. Assessment parameters include:

- 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 system treatment history;
- Vessel location and movement history (infection risk since anti-fouling coating application or verified IMS inspection); and
- Location and duration of the planned activity within 12 nm of the 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 IMR activities with respect to IMS risk.

Where the 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 Otway ports. 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.

7.2.4 Impact and Risk Management

HSEC risks are identified, assessed and either eliminated or appropriately controlled to reduce potential harm to personnel and the environment. The risk level of an activity determines the level of management approval required to undertake that activity.

The Cooper risk management processes use qualitative, semi quantitative and quantitative risk assessment or hazard studies to determine risks and opportunities related to activities that Cooper controls or has influence over in accordance with the Risk Management standard instruction.

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

The CHN operations activity has been assessed for impact and risk utilising the Cooper Qualitative Risk Matrix and risk management process. This process also outlines the authorised roles for risk acceptance and treatment plan approval.

Environmental hazard identification is carried out throughout the life of the CHN assets. Qualitative risk assessments are based upon the principles of ISO 31000. These assessments are typically undertaken for operational or task based activities and may be conducted:

- As part of a Job Hazard Analysis prior to completion of a work permit;
- In an incident assessment and investigation;
- 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 offshore IMR campaigns it is the responsibility of the Cooper General Manager Operations to ensure that a competent contractor is used to perform the work. In addition, a campaign-specific risk assessment is undertaken considering all impacts and risks associated with the proposed scope of works to ensure that impacts and risks are managed to ALARP and acceptable levels.

7.2.5 Management of Change

The Cooper Management of Change (MOC) process describes the requirements for dealing with change and requires all changes to engineering activities, safety critical procedures, operations, facilities, processes, equipment, plant, materials and/or controlled management system documentation changes to be assessed and managed.

This standard details the process requirements to ensure that when changes are made to a project, control systems, an organisational structure or to personnel, the HSE risks and other impacts of such changes are identified and appropriately managed.

The objective of the MOC process is to ensure that additional risks are not introduced by the change that could increase the risk of harm to people, assets or the environment. This includes:

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

Environmentally relevant changes include:

- New activities, assets, equipment, processes or procedures proposed or implemented that have the potential to impact on the environment and have not been:
  - Assessed for environmental impact previously, in accordance with the relevant standard; and
  - Authorised in 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

- Change to the requirements of an existing external approval (e.g. changes to conditions of environmental licences).

An impact/risk assessment will accompany any MOC with identified environmental impacts or risks in accordance with the Cooper Risk Management Standard. The impact or risk assessment will consider the impact of the proposed change on the environmental impacts/risks and adopted control measures. It will also consider impacts and risks to stakeholders and seek their feedback on proposed changes if their interests are affected by the change.

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 meet the nominated EPOs and EPSs set out in the accepted EP for the activity. The 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.

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

Note for changes to the accepted EP, all changes will be traceable via ‘track-changes’ within the revision document and any changes made are fully justified.

7.2.6 Internal Reporting

7.2.7 Performance Reporting

Routine internal performance reporting of HSE matters includes the following:

- Operations reports – the Operations Superintendent (for routine onshore operations) and the Cooper Site Representative (for vessel-based activities) will prepare a routine operations report, including data on activities conducted for the day and any HSE issues arising. This will be issued to the Cooper General Manager Operations who will then distribute to the extended project team as required;
- Environmental performance report – Cooper will prepare an annual EP performance report detailing the outcomes of each performance standard in the EP. This will be submitted to the DEDJTR and NOPSEMA within 3 months of the end of the reporting year.

7.2.8 Incident Recording and Reporting

All environmental incidents (i.e., non-compliances with the EPOs and EPSs must be communicated immediately to the Cooper General Manager Operations and are recorded and investigated in accordance with Coopers Incident Management process. Recording and close out of corrective actions are tracked to closure in the Cooper’s incident action tracking system.

Incident investigations are initiated and closed out in a timely manner and learnings associated with incidents and near misses are communicated across the organisation. Cooper will lead an investigation into the cause, effects and learnings of an incident. Where circumstances warrant it, such an investigation will be conducted jointly with the IMR vessel contractor. Following an investigation, Cooper (and the vessel contractor) will develop remedial actions and communicate these to relevant personnel with the aim of preventing a reoccurrence of the incident.

Risk registers 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).

7.2.9 Environmental Performance Monitoring and Reporting

7.2.10 Emissions Monitoring

Cooper will maintain a quantitative record of emissions and discharges CHN operational activities. For routine operations and maintenance activities, the Iona Gas Plant Manager is responsible for collecting data and reporting it to Cooper. For vessel-based IMR activities the Cooper Offshore Site Representative is responsible for collecting this data.

A summary of these results will be reported in the annual EP performance report submitted to NOPSEMA and DEDJTR. Copies of emission and discharge records will be retained in the Cooper document management system.

7.2.11 Operational and Scientific Monitoring Plan

The Cooper Offshore Victoria OSMP contains details regarding the triggers for commencing operational and scientific monitoring, who will conduct the monitoring and what will be monitored. This document supports the Cooper Offshore Victoria Oil Pollution Emergency Plan by:

- Detailing operational monitoring (Type 1) requirements to be implemented in a level 2/3 spill to inform spill response activities; and
- Scientific monitoring (Type II) to quantify the nature of extent, severity and persistence of environmental impacts from a spill event and inform on appropriate remediation activities.

Cooper has engaged scientific support contractors to assist with the implementation of the OSMP.

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

7.2.12 Audit and Inspection

Vessel Activities: Environmental performance of the CHN assets and vessel-based IMR activities will be audited and reviewed to ensure that environmental performance is being achieved, potential non-compliances and opportunities for continuous improvement are identified; and all environmental monitoring requirements are being met.

The following arrangements will review the environmental performance of vessel-based activities:

- Due-diligence pre-activity inspection/audit of the IMR vessel may 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 (as described in prequalification material) to enable compliance with this EP;
- Campaign inspections of the vessel by the Cooper Site Representative to verify vessel activities are in compliance with this EP. Regular inspections using an environmental checklist will be completed during the activity.

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

Environment Plan Compliance: Independent of these vessel-based inspection/audit activities, Cooper shall undertake an annual compliance audit of the commitment contained in this Environment Plan and assess the effectiveness of the implementation strategy.

Any non-compliance with the environmental performance standards outlined in this EP will be subject to investigation and follow-up action as per 'management of non-conformance' requirements.

The findings and recommendations of inspections and audits will be documented and opportunities for improvement or non-compliances noted will be communicated to all relevant personnel at the time of the audit to ensure adequate time to implement corrective actions. Results from the environmental inspections and audits will be summarised in the annual EP performance report submitted to the DEDJTR and NOPSEMA.

Oil Spill Response Equipment/Service Assurance: Cooper will undertake regular assurance activities on oil spill response support services. This will include:

- For both the OSMP scientific and aviation supplier, an annual audit and review of equipment and processes necessary to implement effective oil spill response. Audit outcomes will be documented and corrective actions monitored in accordance with the Management of Non-conformance Process.
- The Australian Marine Oil Spill Centre (AMOSC) has in place an annual auditing assurance process by member companies which assesses equipment capability/capacity; competencies to support an industry based oil spill response; and readiness to respond to a level 3 industry-based incident.

  Audit results are published on the AMOSC website for members to assure themselves of AMOSC's capability, identify any deficiencies which may affect individual response plans and monitor closeout of actions. This is further supported by AMOSC member forums where issues can be raised by individual member companies. Cooper considers that this assurance process is suitable for the CHN asset spill risk and does not intend to separately audit AMOSC resources.

7.2.13 Management of non-conformance

In response to any EP non-compliances, corrective actions will be issued which specify the remedial action required to fix the breach and prevent its reoccurrence. The corrective action is closed out only when the remedial action has been verified by the appropriate manager and signed off. The status of the corrective action is monitored through the Cooper corrective action tracking system.

Where more immediacy is required during vessel-based IMR activities, non-compliances are communicated to relevant personnel immediately and responded to as soon as possible. The results of these actions are communicated to the offshore crew during daily toolbox meetings and at daily or weekly HSE meetings.

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

7.2.14 Management Review

Formal review is undertaken on the performance of the HSEC management system by Cooper management to ensure that the system continues to be suitable, adequate effective and is continuously improved. This is undertaken, at a minimum, on an annual basis in accordance with the Management Review Standards.

8 Oil Pollution Emergency Plan

8.1 General

8.1.1 Oil Spill Response Strategies

The Offshore Victoria Oil Pollution Emergency Plan (OPEP) is Cooper's response strategy in the event of a hydrocarbon spill during CHN operational activities. The OPEP has been accepted by NOPSEMA and DEDJTR as compliant with the Commonwealth OPGGSER and Victorian Offshore Petroleum and Greenhouse Gas Storage Regulations 2011(OPGGSR).

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

Cooper have utilised a Net Environmental Benefit Assessment (NEBA) methodology to identify the appropriate response strategies for hydrocarbon spill scenarios possible during CHN operational 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 condensate, and the potential for shoreline residue impacts associated with MDO spills, the response strategy would include the following according to the specific scenario:

- Initiate **source control**:
  - For vessels, this includes the implementation of SMPEP actions to reduce the leak;
  - For pipelines this includes operator response and ESD systems;
  - For CHN well releases this may include:
    - Vessel-based intervention via a work-class ROV; or
    - Well capping and/or relief well installation;
- **Monitor and evaluate** the spill via aerial and/or marine surveillance and oil spill trajectory modelling (all spill types) and via oil spill tracking buoys (for IMR vessel MDO spills);
- Initiate **protection and deflection** booming within estuaries which may be at risk (for nearshore IMR vessel MDO spills);
- Initiate **shoreline assessment and clean-up** (MDO and condensate spills) (where access is possible); and
- Initiate **oiled wildlife response** where oiled wildlife are observed (MDO and condensate spills).

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

8.1.2 Overview of Response Strategy Impact and Risk Assessment

Response strategies which involve marine or vessel-based activities will typically have environmental impacts and risks arising from the activities similar to those already described in Section 6. Where oil spill response activity includes activities not covered in IMR activities, new equipment or emissions/discharges and additional impacts and risks exist, an assessment has been provided in Table 8-1 (below).

Table 8-1: Oil Spill Response Strategy Impact and Risk Assessment

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Source Control (MODU-based Relief Well Drilling)	**Drill mud and Cuttings Discharges (IMPACT)**: Smothering of marine benthic habitats and seabed sedimentation structure, possible toxicity impacts from water-based mud additives and temporary alteration to water quality (turbidity)	*Cuttings:* The distance and depth of solids accumulation around the well location depends upon the volume released, current speed and direction, particulate size and the water depth. Based upon previous drilling undertaken at the Minerva wellsite, located in 60m of water (similar water depths to CHN wells), monitoring (grab sampling and video assessment) confirmed that the physical influence of drilling was initially restricted to approximately 100m from the wellhead. Drill cuttings remained present in samples taken from the wellhead site 4 months after the completion of drilling, however no drill cuttings were observed at any of the grab sampling stations 11 months after drilling, most probably because of sediment reworking due to natural hydrodynamic processes (Currie & Isaacs, 2005). Currie and Isaacs (2005) also identified that changes in abundance of benthic communities reduced within 100m of the wellhead, however in most cases these changes became undetectable four months after drilling. This was also observed in eastern Bass Strait at the Esso Fortescue Platform in 70 m water depths, where resuspension of drilling sediments have been observed and benthic habitats given the sandy seabed environment rapidly re-established (Terrens et al. 1998). The seabed habitats at CHN relief well locations are expected to be similar to the seabed at the existing well sites which consists of concreted outcroppings with very low relief and structural complexity separated by gullies of sand or fine gravel sparsely covered by epifauna (sponges and also probably hydrozoans, bryozoans and algae). It is possible that areas of the non-location specific 'Shelf Rocky reef and hard substrate' KEF are present in the area. However, on the basis of observed impacts from other developments in the area, seabed sedimentation impacts are expected to be temporary, localised and rapidly recolonised (negligible consequence) with changes undetectable months after drilling. *Water-based muds* (WBM) are proposed for relief well activities. Minor quantities of WBM adhere to cuttings discharged overboard and may form a visible plume which extends from the rig in the prevailing current direction. Visible plumes may also be evident when muds are discharged at the end of a well section, however this discharge rapidly disperses and dilutes in the Bass Strait marine environment. In Australia, the plume is typically visible not more than 1 km from the discharge point (Hinwood et al, 1994). As any relief wells will be located at least 30 km from shore, visual amenity impacts at adjacent shorelines are not expected. Plume discharges will be temporary and localised (negligible consequence). WBM chemicals discharged have the potential to impact to marine life. Cooper utilises the UK OCNS system standard to assess the environmental performance of chemicals to ensure high environmental performance chemicals are selected which meet the technical requirements for drilling. Additives assessed as low toxicity, biodegradable and having no bioaccumulation potential are utilised. Given the localised nature of the discharge, impacts to water quality and secondary impacts to marine fauna are assessed as having a negligible consequence.	WBM additives are of OCNS CHARM rating of GOLD or SILVER, a non-CHARM "E", "D" or PLONOR classification to minimise eco-toxicity impacts Cuttings treatment system is monitored on a full-time basis to maximize system performance	NEGLIGIBLE

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Source Control (MODU-based Relief Well Drilling)	**Cementing operations and cement residue discharges (IMPACT):** Water quality impacts, ingestion of chemical residues by marine species and alteration to seabed sediments	Cement used in the drilling program guarantees well integrity. The conductor is drilled and cemented in place with the cement returns taken to the seafloor. All subsequent casing strings are cemented below the mudline and the cement returns will not be discharged. Cement additives are selected in accordance with the Cooper chemical management standards and have a CHARM rating of Gold or Silver, non-CHARM rating of "D" or "E" or pose little to no risk to the environment (PLONOR). Minor volumes of cement discharged to the seabed during conductor installation may result in localised smothering of benthic fauna and habitat however given its low toxicity and small area affected, impacts are negligible. During drilling operations, small volumes of excess cement (~1.6 m^3) per well section are disposed to the marine environment. Given the low environmental hazard presented by this discharge and the small volume, impacts are considered negligible.	Cement additives are of OCNS CHARM rating of GOLD or SILVER, a non-CHARM "E", "D" or PLONOR classification to minimise eco-toxicity impacts Excess cement at the end of drilling program shall be returned to shore for disposal, provided to next titleholder or disposed downhole during plug and abandon activities	NEGLIGIBLE
	Blowout Preventer (BOP) Hydraulic Fluid Discharge (IMPACT): Water quality impacts, possible toxicity impacts to marine species	The BOP is regularly function tested. As part of BOP testing, small volumes of hydraulic fluid (generally a water-based glycol mixture) are released to the environment. Approximately 300 to 350 litres of base chemical diluted in water may be discharged to the marine environment during the drilling of a typical well. Chemicals utilised as hydraulic fluids will meet Cooper Energy's chemical selection criteria. Given the intermittent testing of these valves, the low toxicity fluid utilised and the dispersion and dilution which occurs in Bass Strait, and impacts will be localised and temporary (i.e. negligible consequence).	Hydraulic fluid is OCNS CHARM rating of GOLD or SILVER, a non-CHARM "E", "D" or PLONOR classification to minimise eco-toxicity impacts	NEGLIGIBLE
	Bunkering spill (RISK): Water quality impacts within the spill EMBA with impacts to marine fauna (including commercial fish) and possible shoreline impacts	MODU operations require fuel bunkering from supply vessels during drilling. All vessel operations within the MODU's PSZ are strictly controlled by the Offshore Installation Manager (OIM) in accordance with the relevant Marine Operations Manual and a Summary of Operational Boundaries (SOOB) matrix. This activity is only undertaken in suitable weather conditions, is fully supervised and utilises equipment which is fit-for-purpose including dry-break couplings. Impacts from spills which may result from bunkering (volume size ~ 15m^3) offshore are expected to be similar to those from an offshore IMR vessel spill (i.e. primarily marine-based with possible minor shoreline residue impacts). On the basis that the spill is considered to have localised shot-term impacts but not affecting ecosystem functioning (minor consequence). DNV (2011) documented, based upon AMSA data from 1982-2010 for offshore oil and gas facilities, that only one diesel loading spill of volume less than 1 tonne occurred. On the basis of this information, a refuelling spill size of 15m^3 has a frequency of 1×10^{-4} per year (unlikely). Accordingly, with controls applied, the residual risk of a refuelling spill is low.	Bunkering activities are fully supervised in accordance with approved procedures as detailed on the Permit-to-Work All transfer equipment are maintained in accordance with the MODU's Planned Maintenance System and inspected prior to use Crews undertake routine drills to ensure they are familiar with response requirements Vessel/MODU SMPEP is implemented in a bunkering spill incident to mitigate impacts. The Cooper OPEP/OSMP is implemented to reduce impacts from the spill.	LOW

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Source Control (MODU-based Relief Well Drilling)	**Well LOC during relief well drilling (RISK):** Water quality and marine fauna impacts	In drilling a relief well to obtain well control, there is the potential for a well blowout to occur. In the case of the CHN wells this would be similar to the blowout impacts observed in Section 6.21 for well integrity issues. Section 6.21 provides an assessment of a LOC of condensate from a well blowout. In the event of a blowout impacts would be expected to be localised, however given the continued release over a number of months in an area this is assessed at a minor consequence. DNV (2011) documents frequencies for “loss of well control” incidents associated with the drilling of development wells is estimated at 6.0 x 10^{-5} per well drilled. This frequency applies to well operations to a North Sea standard comparable to Australia. Accordingly the likelihood of blowout is considered remote and the risk is assessed as low.	Drilling crew is qualified to IWCF Well Control standards, MODU and Cooper competency requirements. Continuous monitoring of mud flow parameters to detect LOC conditions. LWD tools measure formation properties to inform drillers of anomalies. BOP system is installed prior to entering any hydrocarbon-bearing zone. BOP system is routinely tested. Cement testing is undertaken to ensure it will isolate the well from formation. Routine/surprise MODU blowout drills ensure personnel as familiar with response requirements Cooper undertakes a pre-spud ERP/OPEP exercise to test campaign arrangements. ERP and OPEP implemented to manage and mitigate impacts. Cooper Victorian Source Control Plan is implement in well LOC event Operational and scientific monitoring is undertaken in accordance with the Cooper OSMP.	LOW

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Monitor & Evaluate (Aerial & Vessel Observation)	Sound interference with marine fauna causing behavioural disruption to whales, pinnipeds and shoreline bird species.	**Aviation**: 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 animal's activity. 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. Aerial surveillance platforms will operate at between 300 – 500 m altitudes when undertaking observation activities (AMSA, 2003). 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. Noise produced by surveillance aircraft is localised and temporary as the platform is in constant movement. On this basis impact to cetaceans, pinnipeds or shoreline bird species is expected to be temporary, localised and recoverable (negligible consequence). **Vessels**: Disturbance to cetaceans in open ocean habitats from underwater sound associated with vessels has been assessed in Section 6.7. Vessel movement near seal colonies can also cause disturbance particularly during breeding periods (November to December). Lady Julia Percy Island is a breeding location for seals and therefore controls required under the Victorian Wildlife (Marine Mammal) Regulations are invoked for significant or protected seal colonies. Seals in the water tolerate close and frequent approaches by vessels and if on land, rarely react unless the considered a boat approaches within 100-200 m. Cooper Energy will consult Parks Victoria prior to initiating any operational or scientific monitoring near Lady Julia Percy Island to prevent disturbance (negligible consequence).	Surveillance aircraft will ensure buffer distances of 500m (helicopters) and 300m (fixed wing) are maintained in accordance with EPBC Regulations 2000 (Part 8) to whales and dolphins. Cooper Energy seeks input from Parks Victoria (via DEDJTR) to understand the controls that must be adopted for and vessel activity near Lady Julia Percy Island during operational monitoring for a MDO spill	NEGLIGIBLE

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Protect & Deflect (Shoreline Boom & Oil Collection Facilities)	Loss of vegetation and impacts to associated fauna habitats while deploying boom (IMPACT)	An operational NEBA will be undertaken at the time of a spill if the inlet is open, with DEDJTR, land and waterway managers to determine if there is a net benefit in undertaking boom deployment. The booming location will be confirmed with local waterway managers to ensure estuarine impacts are controlled and minimised.	*Use of Existing Tracks and Pathways*- Access outside of existing tracks and pathways in determined in consultation with DEDJTR EMD.	NEGLIGIBLE
	Restricting access to the area for recreational activities (IMPACT)		*Land and Waterway Manager Consultation* - In conjunction with DEDJTR, consultation is undertaken with land and waterway manager prior to deployment of equipment to establish recreational user controls along the affected coastline.	NEGLIGIBLE
	Oil spill from waste handling (RISK)		*Waste Facility Operation* - Waste storage tanks and hoses are within a contained, impervious area where possible in a shallow trench/pit. Spill kits available at oil recovery area. Area is under supervision and secured from public access. *Waste Disposal* - Collected waste is disposed in accordance with Victorian EPA waste disposal requirements *Spills Reported* - Spills from water-handling facilities are reported to Cooper and other external reporting requirements	LOW

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
Shoreline Assessment & Clean-up	Impacts to native vegetation, aboriginal cultural heritage and fauna habitats due to personnel access (IMPACT).	The noise and general disturbance created by shoreline clean-up activities are likely to disturb the feeding, breeding, nesting or resting activities of resident and migratory fauna species present (such as hooded plovers). For example, the eggs of hooded plovers are small and well camouflaged, so they are easily damaged. If the incubating adult is scared away from the nest, the eggs may overheat/become too cold with no subsequent hatching. Similarly, if a chick is disturbed, it quickly runs into the sand dunes and hides using up valuable energy and while hiding it is unable to feed and can easily starve (Birdlife Australia, 2017). Any erosion caused by responder access to sandy beaches, or the removal of sand, may also bury nests. This is unlikely to have impacts at the population level and with controls adopted is likely to have a negligible consequence. The movement of people through backshore and dune areas may disturb cultural heritage artefacts. The most likely artefacts present are Aboriginal shell middens, especially where freshwater and brackish water sources occur nearby, such as the Curdies inlet estuary. Disturbance or damage to such sites will be minimised by fencing off such areas and reporting its presence to relevant state agencies and ensuring shoreline access is undertaken via established pathways (negligible consequence). The presence of stranded oil and clean-up operations may necessitate temporary beach closures (possibly weeks). This means recreational activities (such as swimming, walking, fishing, boating) in affected areas will be excluded until access is again granted by local authorities. Given the prevalence of rocky shorelines in the EMBA, this is unlikely to present a significant social or tourism drawback (negligible consequence). The influx of shoreline clean-up personnel to a given region will place increased demand on the resources of small coastal towns in the EMBA, such as accommodation, meals, vehicle hire, fuel, groceries and other day-to-day consumables. In most instances, the increased activity associated with clean-up operations will be a welcome boost to local economies, however sudden influxes of workers to small Australian towns is often	*Use of Existing Tracks and Pathways- Personnel* - Access to shoreline is via established tracks and pathways to protect vegetation/aboriginal heritage. Access outside of existing tracks and pathways in determined in consultation with DEDJTR EMD. *Shoreline bird protection* - In consultation with the relevant land manager to protect shoreline birds, any mobile equipment on beaches will be driven as close to the water's edge as possible. *Fauna Handling* Only DELWP trained oiled wildlife officers will approach and handle fauna.	NEGLIGIBLE
	Recreational user exclusion to beach during clean-up activity (IMPACT)		*Land Manager Consultation* In conjunction with DEDJTR, consultation undertaken with shoreline land manager if clean-up activities is required to determine controls to prevent recreational user exposure to oil residues.	NEGLIGIBLE

Response Option	Potential Impact/Risk	Assessment of Impact/Risk	Controls	Residual Impact/Risk
	Spread of contamination due to poor secondary contamination management (RISK).	fraught with social unrest as the demand for goods and services can negatively impact on the provision of services to residents and tourists. As with most of the risks associated with clean-up operations, this is likely to be temporary and localised.	*Waste Facility Operation* - Waste storage is located within a contained, impervious area. Area is under supervision and secured from the public. *Waste Disposal* - Oiled waste is disposed in accordance with EPA waste disposal requirements. *Decontamination Points*- All access points (personnel and equipment) will be controlled via designated access points through decontamination facilities. *Contamination Spread Reported* - Incidents of contamination outside the 'hot-zone' are reported to Cooper and to external reporting requirements.	LOW
Oiled Wildlife Response	Inappropriate handling may lead to disturbance, injury or death of fauna (RISK)	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 Cooper personnel and reduce the potential for distress, injury or death of a species (low residual risk).	*Cooper Inductions* Wildlife is only approached or handled by DELWP trained oiled wildlife responders. Cooper personnel are advised of wildlife interaction restrictions through site safety inductions.	LOW

8.2 Oil Spill Response Arrangements

Cooper has 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 with response equipment from national stockpiles and trained personnel;
- A service agreement to provide specialist resources for scientific monitoring, analytical services, scientific monitoring vessels and sampling equipment;
- Contract pre-qualification with an aviation supplier for provision of surveillance aircraft and pilots; and
- Contract with a vessel contractor for marine vessel support during an oil spill.

Source control arrangements for well incidents include an agreement with well control specialists (including capping stack capability), well engineering company, casing material suppliers and the APPEA Mutual Assistance Agreement for rig provision.

8.3 Preparedness

8.3.1 Emergency Response

For CHN infrastructure emergencies, first response to an emergency is by Lochard Energy personnel as per the Iona Gas Plant Emergency Response Plan (ERP) who notifies Cooper of emergency incidents. Cooper Energy operates under the Victorian Emergency Management Plan (VEMP) to ensure timely response and effective management of any emergency. This includes environmental incidents and any incidents arising as a result of a hydrocarbon spill. For hydrocarbon spills, the response is managed by the Cooper Offshore Victoria 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 Cooper Emergency Management Team (EMT) 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 with 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 an effective response; and reporting procedures in the event of a spill.

8.3.2 Training

Key Cooper and vessel positions to initiate and manage spill response are identified within the Cooper Offshore Victoria OPEP. Cooper position descriptions identify responsibilities for maintaining oil spill response capability and preparedness. Persons fulfilling Cooper's operational/emergency roles outline the necessary qualifications required to undertake the role.

All contractors engaged on CHN asset activities have equivalent resource management systems to ensure equivalent levels of personnel competency and training as required.

All IMR vessel personnel have full inductions into the CHN operations EP and OPEP requirements prior to the commencement of vessel activities.

8.4 Testing of Response Arrangements

To ensure readiness oil spill response exercises are conducted in accordance with the exercise schedule contained in the CHN Environment Plan. Testing is undertaken when arrangements are first introduced, 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 Cooper General Manager Operations is responsible for ensuring changes are assessed against the Commonwealth OPGGSER and Victorian OPGGSR regulatory revision criteria and where necessary, the OPEP is revised and submitted to NOPSEMA and/or DEDJTR as a formal revision.

9 Consultation

Cooper has consulted with stakeholders in the preparation of the CHN Environment Plan. Cooper has contacted stakeholders known through reviewing the previous titleholder's consultation records, review of Commonwealth and State fishing information and other identified contacts to establish working relationships with stakeholders that have functions, interest or activities in the CHN asset areas.

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	
Department of Environment (DoE) - Parks Australia	Australian Fisheries Management Authority (AFMA)
National Offshore Petroleum Titles Administrator (NOPTA)	Department of Innovation, Industry and Science (DIIS)
Australian Maritime Safety Authority (AMSA)	Department of Defence (DoD)
Maritime Border Command (MBC)	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)	DEDJTR – Fisheries Victoria
Transport Safety Victoria (Maritime Safety)	
The Department of the responsible State Minister, or the responsible Northern Territory Minister	
DEDJTR – Earth Resources Regulation (ERR)	
A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
Fisheries:	
Commonwealth Fisheries Authority	Apollo Bay Fisherman's Cooperative
Seafood Industry Victoria (SIV)	Port Campbell Professional Fisherman's Association
Warrnambool Professional Fishernan's Association	Victorian Recreational Fishers Association (VRFish)
Victorian Rock Lobster Association (VRLA)	Portland Professional Fisherman's Association
Victorian Abalone Divers Association (VADA)	Western Abalone Divers Association (WADA)
Central Zone Abalone Association (AVCZ)	South-east Fishing Trawl Industry Association (SETFIA)
Southern Shark Industry Alliance	Sustainable Shark Fishing Inc. (SSF)
Oil Spill preparedness and response agencies:	
Australian Marine Oil Spill Centre (AMOSC)	DEDJTR – Marine Pollution Branch
Parks Victoria – Port Campbell	Department of Environment, Land, Water and Planning *(DELWP)*
Lochard Energy Incorporated	
Nearby Titleholders:	
Origin Energy Resources Ltd	BHP Billiton Petroleum (Victoria) Pty Ltd
WHL Limited	3D Oil T49P Pty Ltd

Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
Local Government	
Corangamite Shire Council	
Any other person or organisation that the Titleholder considers relevant	
Community interests:	
Parks Victoria (Port Campbell office)	Port Campbell Tourism and Information Centre
Port Campbell Boat Charters	Scuba Divers Federation of Victoria (SDFV)
Conservation interests:	
Bay of Islands Coastal Park	

9.2 Consultation (Environment Plan Collation)

Stakeholders identified in Table 9-1 were engaged during the collation of this Environment Plan. Stakeholders were contacted directly by phone as an introductory activity to confirm stakeholder relevance to the asset, activities and interests in relation to CHN activities; to identify further opportunities for engagement; and confirm contact details were correct for the delivery of future correspondence. A letter formally introducing Cooper, the acquisition of the CHN assets, a brief description of the assets and Cooper contact details was sent by email in December 2016.

No concerns or objections have been raised with regard to the continued operation of the CHN 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 assets have been operating for over 10 years without any major incidents.

For those stakeholders which responded, the key theme emerging was that Cooper maintains ongoing engagement and conversation on future activities (Fishing Associations) and ensuring that Cooper has an awareness of the abalone fishery when undertaking activities (abalone associations).

A stakeholder consultation summary undertaken to date, together with Cooper'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 activities may be affected by the assets' operations. It also includes key stakeholders with whom engagement has taken place to enable Cooper to determine whether they are 'relevant persons' for the CHN activity.

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) Interests: New Facilities/expanded footprint which may impact commercial fishery access to seabed areas	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	Not Applicable	Not Applicable
Commonwealth Fisheries Association	Peak Group for Commonwealth Fisheries Interests: Increased footprint of activities Activity Notifications	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	Not Applicable	Not Applicable
Seafood Industry Victoria	Peak Industry Body for Victorian seafood and fisheries Interests: Increased footprint of activities Activity notifications	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
Victorian Rock Lobster Association	Rock Lobster Interests Sound impacts to Lobsters. Interference with fishing equipment deployed.	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	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
Sustainable Shark Fishing Inc.	Peak Group for Victorian Seafood – Shark Fishing Interests: Increased footprint of activities Activity notifications	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
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	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	No objection to advice obtained	AHO have previously advised an updated email address, this information is incorporated into the including stakeholder engagement register and OPEP addendum Contacts directory (VIC-ER-EMP- 0020).
Apollo Bay Fishermen's Cooperative	Industry cooperative for Victorian fishery within offshore Otway region	2016.12.23 Phone call – contact details check, Russell Frost stakeholder provided an updated email address. 2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to advice obtained.	Not Applicable
Marine Border Command	Integrated defence/customs organisation which provides security for offshore marine areas	2017.03.08 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2017.03.08	No objection to 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
Port Campbell Professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to advice obtained.	Not Applicable
South-East Trawl Fishing Industry Association	Peak Industry Group for Trawl Fishermen in the SE Region Interests: Activity Notifications Change in Operation New activities or increased footprint Fishing Damages	Cooper Energy has been liaising with SETFIA since mid-2012 with respect to Stakeholder Engagement mechanisms established for the BMG field asset, ongoing initiatives have developed between Cooper Energy and SETFIA since.			
		2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	2017.01.02 Email – SETFIA acknowledgement of information provided. Email - J Hinks seeking phone conversation to organise quarterly BMG Fishery risk review and discussion to include other offshore assets.	No objection to request or advice obtained	Not Applicable
			Email calendar invite for phone conversation between SETFIA (S Boag) and Cooper Energy (J Hinks) 2017.02.08 Phone conversation between SETFIA (S Boag) and Cooper Energy (J Hinks) included: • Agenda items for upcoming formal meeting • 2018 Fishing Industry Survey (FIS) – SETFIA to provide map of survey sites, schedule and duration impacts on any scheduled activities	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
South-East Trawl Fishing Industry Association (Con't)			2017.02.22 Email calendar invite for formal meeting to be held on 2017.03.01 between Cooper Energy, Upstream P.S and SETFIA representatives 2017.03.01 Cancelled scheduled meeting by S Boag due to availability of all attendees. Meeting to be reschedule, mid-March 2017	No objection to invitation request. Await reschedule of Meeting – March 2017	No action required.
Warrnambool professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to details provided	No objection to details provided
Portland Professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	2016.12.23 Phone call – contact details check, Andrew Levings stakeholder provided an updated email address and mailing details for Cooper Energy. Andrew advised his experience as a fishery liaison in the area. 2016.12.28 Email – Letter to Andrew Levings and Posted Letter to David McCarthy Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	Email from A Levings advising title and address for D McCarthy details. Email from A Levings provided his resume as an Oil and Gas Fishery Liaison.	No objection to details provided	Currency of Stakeholder engagement register updated

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
Western Abalone Divers Association (WADA)	Area of Marine use Warrnambool to SA Border Will pass on information to other marine users	Phone Call – Harry Peeters supplied contact details. Phone Call and Email to Geoff Ellis for contact details of the Western and Central Abalone association contacts. 2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to details provided	Currency of Stakeholder engagement register updated
Scuba Divers Federation of Victoria		2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
Parks Victoria - Port Campbell	Adjacent Marine Park	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2017.01.16	No objection to advice obtained	Not Applicable
Central Zone Abalone Industry Association (AVCZ)	Central Zone - largest zone in Victoria (Lake Entrance to Hopkins Rr (Warrnambool) Harvesting is inshore along the coastline and extends no further than 8kms off the coastline	2016.12.22 Email - to AVCZ to obtain contact phone number and contact details, for information on the AVCZ. 2016.12.30 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	2016.12.23 Phone call from Malcom Petrie, provided contact details and a summary of AVCZ activities; • Central Zone being largest zone, spanning from Lakes Entrance to Hopkins Rr (Warrnambool) • Approx. 20 active divers at any one time. The season is continuous. • Abalone Harvesting is inshore along the coastline and extends no further than 8kms.	No further response received. 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
Southern Shark Industry Alliance	Peak Group for Gummy Shark fishing southern Australia	2016.12.29 Email to contact page to obtain contact details for purpose of stakeholder engagement	No Response to email dated 2016.12.29	Not Applicable	Not Applicable
Victorian Recreational Fishers Association (VRFish)	Peak industry body for Victorian seafood and fisheries	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
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	2016.12.23 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback. Also Cooper Energy sort feedback associated with the potential for encounter of third party vessels during survey activities and advice on the precautions which Cooper Energy needs to undertake to prevent third party vessel interference and to preserve safety. 2017.01.16 Follow-up email sent to AMSA seeking feedback to email of 2017.12.23	2017.01.16 Phone call and email correspondence from Nathan Johnson AMSA, Border Force Control (JRCC)	No objection to advice obtained	Cooper Energy to ensure feedback is incorporated into CHN EP (Sections 7 Environmental Impact and Risk Assessment)
		2017.01.25 Email – Cooper Energy sought an MOU with AMSA for specific spill response arrangements relating to the CHN asset.	2017.02.07 Email correspondence from David Imhoff, AMSA with agreement to sign.	No objection to advice obtained Cooper Energy signed the MOU agreement with AMSA	No action.

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
Bairnsdale Air Charter	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.	Email - Confirmation Bairnsdale Air Charter can support Cooper Energy, in the event of an oil/condensate spill offshore Gippsland or Otway.	No response received Cooper Energy to follow-up a response	Not Applicable
Comchart Marine Pty Ltd (Bass Trek & Bass Explorer & Bass Rover)	Vessel Services	Cooper Energy 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 Cooper Energy, by way of a Marine Charter Agreement similar to that in place with Santos	No Issues with comments provided	Cooper Energy to progress a Supplytime 89 Agreement with Comchart Marine Pty Ltd
AMOSC	Oil Spill Response Organisation Review and comment on Cooper Energy Offshore Victorian Oil Pollution Emergency Plan (OPEP) reviewer	Cooper Energy has been liaising with AMOSC since mid-2012 with respect to Oil Spill Response. Cooper Energy maintains an Associate Membership with AMOSC			
		2017.02.08 Email – Review of the Cooper Energy Offshore Victorian OPEP for the CHN EP	2017.02.16 Email AMOSC provided minor feedback on Offshore Victorian OPEP. Cooper Energy updated this OPEP in accordance with the feedback to allow for final review.	Comments received from AMOSC deemed valid and applicable to the CHN field	2017.03.01 All comments incorporated into the OPEP, for finalisation before submission to NOPSEMA
		2017.03.01 Email - Final revision of the Offshore Victorian OPEP sent to AMOSC with comments of 16/2/2017 recognised.	2017.03.07 Email - AMOSC response indicating AMOSC role responsibilities are accurately reflected within the OPEP	No Issues with comments provided	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
GHD	Scientific Monitoring Support during oil spill 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 CHN activity. • Individual study implementation plans - GHD has provided updated drawings which accommodate CHN activities • GHD provided correct details for the OSMP Addendum – Implementation Strategy			
		2017.02.24 Email - Cooper Energy confirm with GHD to act as Principal Investigator for OSMP modules and provide necessary staff and resources to implement the modules for the Cooper Energy 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 Cooper Energy ensures GHD as PI is incorporated into CHN EP, Offshore Victoria OPEP & OSMP and subsidiary documents.
DEDJTR Earth Resources Regulation (ERR)	Department of Economic Development, Jobs, Transport and Resources (Victorian Joint Authority for Offshore Victorian Developments) Regulator offshore to 3mn Victorian coastal Waters	2016.11.22 Meeting – Cooper Energy requested a meeting with DEDJTR representatives by way of introduction of the offshore asset acquisition, changes in titleholder and guidance for approval of Operator and Titleholder acceptance.	Acceptable attendance at meeting	No Issues with comments provided	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
DEDJTR Emergency Management Division (EMD)	Department of Economic Development, Jobs, Transport and Resources (Control Agency for Level 2/3 spills in Victorian waters) Regulator offshore to 3mn Victorian coastal Waters	2017.02.08 Email – to Environment & Scientific Coordinator, Marine Pollution Emergency Management Division for review of the Cooper Energy Offshore Victorian OPEP for the CHN EP.	2017.02.22 Email - EMD provided minor feedback on Offshore Victorian OPEP. Cooper Energy updated this OPEP in accordance with the feedback to allow for final review. Note DEDJTR EMD will also review oil spill response arrangements as part of the Victorian regulator review of the CHN EP (for Victorian waters section).	Comments received from EMD deemed valid and applicable to the CHN field.	2017.03.01 All comments incorporated into the OPEP. Thanked DEDJTR for the current information. Final revision of the Offshore Victorian OPEP sent to AMOSC with comments for finalisation before submission to NOPSEMA
		2017.02.13 Cooper Energy Email request to seeking clarification of DELWP contact for oiled Wildlife response 2017.02.15 DEDJTR EMD response to queries.	DELWP contact is Rodney Vile. Interested in viewing the OSMP (sent to DEDJTR EMD)	All information utilised in oil spill planning and within OPEP. No adverse claims or objections made.	Not Applicable
Department of Environment, Land Water and Planning (DELWP)	Pipeline Regulation, Regulation and Approvals Energy, Environment and Climate Change Group,	2016.11.22 Meeting – Cooper Energy requested a meeting with DELWP representatives by way of introduction of the offshore asset acquisition, changes in titleholder and guidance for approval of Operator and Titleholder acceptance.	Acceptable attendance at meeting	No Issues with comments provided, no forward actions for Cooper Energy	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
Department of Environment, Land Water and Planning (DELWP) (Con't)	State Agency supporting AMSA with oiled wildlife response.	2016.11.30 – Email - Cooper Energy 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; • Relevant actions to be taken	No objections made to the information provided. Included in the OPEP (Oiled Wildlife Response) Section.	Thanked DELWP for the current information.
Origin Energy Resources Ltd	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	Automated Response	Not Applicable	Not Applicable
WHL Limited	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date	Not Applicable	Not Applicable
3D Oil Limited	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date	Not Applicable	Not Applicable
BHP Billiton Petroleum (Victoria) Pty Ltd	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date	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
Coates Hire	Marine oil spills -heavy equipment hire	2017.03.15: Telephone conversation with Heather Parsons (Coates Hire) regarding heavy equipment availability and deployment to port Campbell location. 2017.03.15 Email sent to Coates Hire confirming content of conversation	2017.03.16 Heather confirmed equipment availability and deployment time to a Port Campbell location about 5 hours, a call out service is available 24/7	No adverse claims or objections made	Not Applicable

9.3 Ongoing Consultation

9.3.1 Ongoing Engagement

Cooper has developed and maintains a register of commercial fishers in the Otway Basin building on existing stakeholder engagement related to the Basker-Manta-Gummy field in the Gippsland Basin. Engagement is through ongoing liaison with commercial fishing cooperatives and association members. However to ensure broader communications relevant to new commercial fishers associated with the CHN activities, Cooper has sought the support of these existing stakeholders to identify new stakeholders. This has included members of the abalone associations and other relevant SIV members. Cooper has added an additional ten relevant fishing stakeholders to their existing register via this methodology.

Cooper expects additional stakeholders not currently identified in this EP may be affected by CHN asset operations, and that these stakeholders may only become known to Cooper through on-going engagement and consultation carried forward. The stakeholder engagement register will be updated as this occurs.

Cooper Energy Website:

Project information has been made available on the Cooper Energy 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 CHN asset operations activity. Key milestones that will trigger further consultation include:

- Environment Plan acceptance and the availability of the Environment Plan Summary on the NOPSEMA and DEDJTR websites;
- Inspection, Maintenance and Repair (IMR) activity;
- Any significant incidents (e.g., large hydrocarbon spill);
- Changes to the CHN operational activity and its associate impacts or risks or to the way in which Cooper in managing the impacts and risks;
- Future optimization activities (e.g., drilling of additional production wells or bringing assets back into production);
- When a decision is made to decommission the assets.

9.3.3 IMR Activity Consultation

At least four weeks prior to the IMR activity, Cooper will provide to all relevant stakeholders (Fishing Industry Bodies, AHS and TSV) information relating to the following:

- The expected timing, duration and location of the survey;
- Vessel name and call sign (if known);
- A description of the activities which are being undertaken;
- Expected impacts associated with the activity;
- A request to provide feedback on the activities; and
- The Cooper Representative for feedback of issues and concerns.

Any feedback, claims or objections from stakeholders will be assessed for merit and Cooper will provide a response.

Cooper will follow-up with stakeholders providing notifications five days prior to activity commencement (or as requested by the individual stakeholder) and a demobilisation notification will be provided within 10 days of completion of the activity (or at a period requested by stakeholder).

9.3.4 Ongoing Feedback and Response

Should stakeholder feedback identify issues or concerns prior to or during IMR activities, or during the CHN operational phase in general, that were not previously identified in the preparation of the Environment Plan, the impacts and risks will be assessed and if a significant new or increased impact or risk is identified, the Environment Plan will be reviewed and, as necessary, revised and resubmitted to NOPSEMA and DEDJTR for assessment. If the stakeholder feedback, after assessment, results in a change to operations or procedures but is not considered to result in a significant new or increased impact or risk, the Environment Plan will be updated in accordance with the Cooper Management of Change process.

In the event that a change to the CHN operational activity is planned which alters the impacts and risks or alters the way those impacts and risks are managed, Cooper will consult with stakeholders, request and obtain feedback from stakeholders to ensure that impacts and risks to stakeholders are managed to levels which are acceptable and ALARP.

10 Titleholder Nominated Liaison Person

Further information associated with the environmental aspects of the CHN Operations Phase activities may be obtained from Cooper by writing to:

Iain MacDougall

General Manager Operations

Cooper Energy

Level 10, 60 Waymouth Street, Adelaide, SA, 5000

Phone: (08) 8100 4900

Email: iainm@cooperenergy.com.au

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