Stag 50H and 51H Drilling Environment Plan

GF-70-PLN-I-00008

Rev 1

FACILITY	GF - Stag Field
REVIEW INTERVAL	30 Months

Rev No	**Date**	**Approval**		
		Owner	**Reviewer**	**Approver**
		Drilling & Wells Manager	**Environment Lead**	**Country Manager**
0	21-Jan-22	G. Hattersley	N. Merdith	D. Lamb
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Mobile Offshore Drilling Unit – Offshore Installation Manager

Stag Central Production Facility – Offshore Installation Manager

Vessel Masters – MODU support vessels

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ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
AFZ	Australian Fishing Zone
AHTS	Anchor handling tug support
ALARP	As low as reasonably practicable
AMP	Australian Marine Parks
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
BIA	Biologically important area
BOD	Biological oxygen demand
BOP	Blowout preventer
BWMS	Ballast Water Management System
CALM	Catenary Anchor Leg Mooring
CH_4	Methane
CHARM	Chemical Hazard and Risk Management
CMMS	Computerised Maintenance Management System
CO_2	Carbon dioxide
CoEP	Code of Environmental Practice
COLREGs	The International Regulations for the Prevention of Collision at Sea
CPF	Central Production Facility
DA	Designated Authority
DAH	Dissolved aromatic hydrocarbon
DAWR	Department of Agriculture and Water Resources
dB re 1 µPa	The decibel units of the pressure spectrum are equivalent to this measure of the attenuation of sound in water
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (now DBCA)
DEWHA	Department of the Environment, Water, Heritage and the Arts (now DAWE)
DIIS	Department of Industry, Innovation and Science
DMIRS	Department of Mines, Industry Regulation and Safety (previously Department of Mines and Petroleum, DMP)
DNP	Director of National Parks
DoF	Department of Fisheries (now DPIRD)
DOEE	Department of the Environment and Energy (now DAWE)
DP	Dynamically Positioned
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industries and Regional Development (previously Department of Fisheries)

Abbreviation	Description
DSWEPaC (now DAWE)	Department of Sustainability, Environment, Water, Population and Communities
dwt	Dry weight tonnes
EEZ	Economic Exclusion Zone
EMBA	Environment that may be affected
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EP	Environment Plan
EPA	Environmental Protection Authority
EPO	Environmental performance outcome
EPS	Environmental performance standard
ESD	Ecologically Sustainable Development
ESP	Electric Submersible Pump
g/m^2	Grams per metre squared
GFU	Gas floatation unit
GHG	Greenhouse gas
HSE	Health, safety and environment
HWU	Hydraulic Workover Unit
Hz	Hertz
IMO	International Maritime Organisation
IMPS	Introduced Marine Pest Species
IPIECA	International Petroleum Industry Environmental Conservation Association
IUCN	International Union for Conservation of Nature
KEFs	Key Ecological Features
kHz	Kilohertz
Kl	Kilolitre
km	Kilometres
Ksm^3	Thousand Standard Cubic Metres
JE	Jadestone Energy (Australia) Pty Ltd
JHA	Job hazard analysis
LC50	Lethal concentration of a compound at which 50% of test species die within a specified timeframe
LAT	Lowest astronomical tide
m	Metres
m^2	Metres squared
m^3	Metres cubed
MARPOL	Marine pollution – International Convention for the Prevention of Pollution from Ships
MASP	Maximum anticipated surface pressure

Abbreviation	Description
MCR	Marine Conservation Reserve
mg/L	Milligrams per litre
MMA	Marine Management Area
mmscfd	Million Standard Cubic Feet per Day
MODU	Mobile offshore drilling unit
MOPO	Matrix of permitted operations
MPRA	Marine Parks and Reserves Authority
N/D	Nipple down
NEBA	Net Environmental Benefit Analysis
NES	National Environmental Significance
Nm	Nautical mile
NO_x	Nitrogen oxides
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NWS	North west shelf
NWSTF	North-West Slope Trawl Fishery
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone Depleting Substances
OGP	Oil and gas producers (association)
OIM	Offshore Installation Manager
OIW	Oil-in-water
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS (E) Regs	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPEP	Oil pollution emergency plan
OPMF	Onslow Prawn Managed Fishery
OSRA	Oil spill response arrangements
P&A	Plug and abandonment
PAH	Polycyclic aromatic hydrocarbons
PHG	Pre-hydrated (bentonite) gel
ppb	Parts per billion
ppm	Parts per million
PMS	Planned maintenance system
PTS	Permanent Threshold Shift
RMR	Riserless mud recovery (system)
ROV	Remote Operated Vehicle
SBFTF	Southern Bluefin Tuna Fishery
SIMOPs	Simultaneous operations

Abbreviation	Description
SO_x	Sulphur oxides
SPRAT	Species profile and threats (database)
STP	Sewage Treatment Plant
SW	South west
TD	Target depth
TPH	Total petroleum hydrocarbons
TRSCSSSV	Tubing retrievable surface controlled subsurface safety valves
TTS	Temporary Threshold Shift
WA	Western Australia
WAF	Water accommodated fraction
WAFIC	WA Fishing Industry Council
WBM	Water-based mud
WCS	Worst credible spill
WEST	Well engineering standards
WSTF	Western Skipjack Tuna Fishery
WTBF	Western Tuna and Billfish Fishery
WOMP	Well Operations Management Plan

ENVIRONMENT PLAN SUMMARY

This Stag Facility 50H and 51H Drilling Environment Plan Summary has been prepared from material provided in this Environment Plan (EP) and associated Oil Pollution Emergency Plan (OPEP). The summary consists of the following as required by Regulation 11(4):

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	Section 1.2
A description of the receiving environment	Section 3 and Appendix B
A description of the activity	Section 2
Details of the environmental impacts and risks	Section 6 and 7
The control measures for the activity	Section 6 and 7
The arrangements for ongoing monitoring of the titleholders' environmental performance	Section 8.3
Response arrangements in the oil pollution emergency plan	Section 8.5 and Oil Pollution Emergency Plan
Consultation already undertaken and plans for ongoing consultation	Section 4 and Appendix E
Details of the titleholders nominated liaison person for the activity	Section 1.4

1. OVERVIEW OF THE ACTIVITY

1.1 Introduction

Jadestone Energy (Australia) Pty Ltd ('Jadestone') is the operator and titleholder of the Stag Field Production and Export Facility (Stag Facility). The facility is in permit area WA-15-L, approximately 60 km northwest of Dampier in approximately 49 m water depth (Figure 1-1). Oil is currently produced from the Stag Reservoir via production wells, and seawater and production water are injected via injection wells.

Ongoing drilling and completions activities are necessary to maintain oil production.

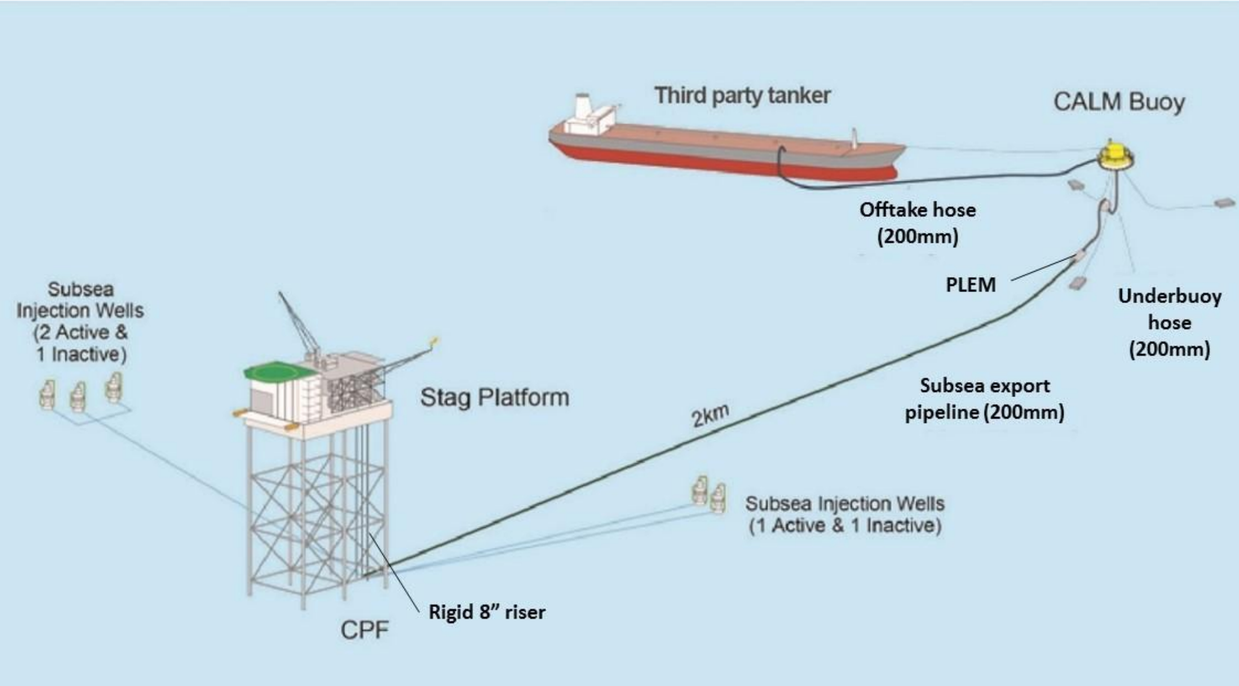

Figure 1-1: Schematic of the Stag Facility (Not to scale)

1.2 Stag Facility Location

The Stag Facility is located on the North-west shelf (NWS) off Western Australia (WA), approximately 60 km north-west of Dampier (Table 1-1).

Table 1-1: Distances from Stag Facility to Key Regional Features

Regional Feature	Distance from Stag Central Processing Facility
Dampier Archipelago	32 km (17.3 Nm)
Closest Montebello Island	75 km (40.5 Nm)
Varanus Island	82 km (44.3 Nm)
Barrow Island	96 km (51.8 Nm)

1.3 Proposed Activity

Over the life of the Stag Facility, drilling activities are required to sustain required oil production rates. Analysis of past and current production data and reservoir characteristics indicate that production levels can be increased with the addition of two new production wells. In order to drill these two new production wells, two existing suboptimal producing wells will have to be first plugged and abandoned (P&A) using a mobile offshore drilling unit (MODU).

The location of the proposed production wells and P&A activity are at the Stag Central Production Facility (CPF) platform, within permit WA-15-L (Figure 1-2).

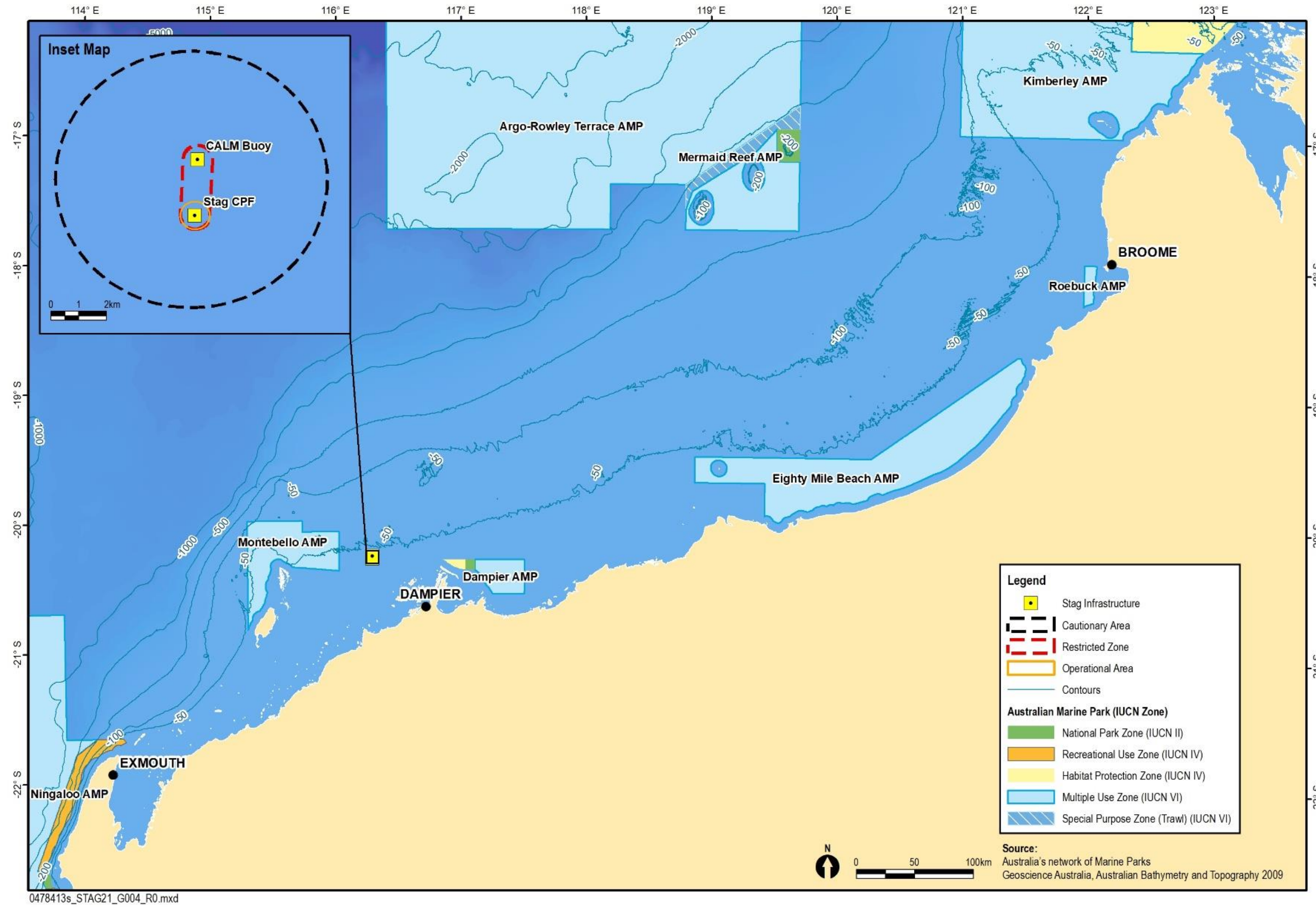

Figure 1-2: Location of the Stag Field

The scope of this Environment Plan (EP) covers the following drilling activities within the Stag permit using a jack-up MODU:

- Plug and abandonment of existing production wells 38-H and 44-H; and
- Drilling of the new production wells 50-H and 51-H at the Stag Central Production Facility (CPF).

This EP applies to activities undertaken within the Operational Area only as defined in the description of the activity (Section 2). Activities that are not covered by this EP are:

- Nearby shipping activity, third-party offtake tankers, and support activities outside the Operational Area;
- Installation activities and vessel based seismic surveys;
- Vessels associated with the Activity when outside the Operational Area which adhere to all applicable maritime regulations, and Commonwealth and State environmental management obligations;
- Commissioning of new production wells;
- Production; and
- Decommissioning.

If any activities proposed within the Operational Area are outside the scope of this EP, they will be the subject of a separate EP or a revision.

1.4 Operator and Titleholder Details

Jadestone is engaged in exploration, appraisal and pre-development activities in South East Asia, with a portfolio of 10 exploration and pre-development assets. Jadestone is an active operator within the region and the Company's principal focus is on assets in Australia, Malaysia, Indonesia, Vietnam and the Philippines.

Jadestone is firmly committed to being a responsible corporate citizen. The Company places safety, environmental and social responsibility considerations at the core of its business and operational decision-making.

Jadestone's Australian office is located at:

The Atrium Building

Level 2, 168 St Georges Terrace

Perth WA 6000.
ACN 613 671 819

Jadestone's contact for the activity is:

Guy Hattersley, Drilling Manager
Phone: +61 8 9486 6600
Email: GHattersley@jadesetone-energy.com

In the event contact details for Jadestone or the liaison contact change within the timeframe of this EP, the Regulator, the National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) will be advised of the updated details.

1.5 HSE Policy

Protecting the environment, valuing cultural heritage and maintaining open stakeholder communication are an integral part of Jadestone Energy's business approach. This is reflected in Jadestone Energy's Health, Safety and Environment (HSE) Policy (Figure 1-3) and this EP.

1.6 Legislative Framework

The drilling activity is located within the Commonwealth Petroleum Jurisdiction Boundary and therefore regulated under Commonwealth legislation; primarily under the OPGGS Act and the OPGGS(E) Regulations. In accordance with Regulation 13(4) of the OPGGS(E) Regulations, this section describes the Commonwealth legislation, international agreements and other relevant guidelines and codes of practice to the activity. In the unlikely event of an unplanned hydrocarbon release that migrates into state waters, Western Australia (WA) or Northern Territory (NT) legislation will be triggered. Applicable Commonwealth and state legislation are listed in Appendix A, with key legislation summarised below:

Offshore Petroleum and Greenhouse Gas Storage Act 2006

The OPGGS Act and OPGGS(E) Regulations specify the requirements to manage the environmental impacts of petroleum activities. The Regulations require that an EP must be accepted by the regulatory authority (NOPSEMA) prior to commencing the proposed activity. NOPSEMA guidelines outline the requirements for the content of EPs.

Environment Protection and Biodiversity Conservation Act 1999

Under Commonwealth government streamlining arrangements, NOPSEMA's assessment of this EP provides consideration of the impacts to matters of national environmental significance (MNES) protected under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This obviates the requirement to refer the project to the Department of Agriculture, Water and the Environment (DAWE).

HEALTH, SAFETY & ENVIRONMENT POLICY

Respect | Integrity | Safety | Results-oriented | Sustainability | Passion

PHILOSOPHY

Jadestone's philosophy is to ensure that health, safety and environmental protection is intrinsic to, and embedded within, our operating activities. The business focusses on those things that deliver top performance and value optimisation while eliminating waste. A focus on HSE performance provides a safe and rewarding work environment for Jadestone employees, and the achievement of sustainable business activities in the local and global communities where they work.

EXECUTION

Within the HSE Policy, Jadestone has committed to:

- Promote a strong HSE culture through visible leadership and an engaged, competent workforce aligned with Jadestone's Shared Values
- Assess all risks and manage them to as low as reasonably practicable
- Maintain an ever-improving HSE management system through setting and monitoring performance targets to achieve our aims within a framework of continuous improvement
- Take all necessary actions to prevent incidents, with an aspiration of targeting zero. Investigate and apply learnings
- Encourage and promote the ownership of HSE performance by all employees and contractors
- Ensure all contractor companies working with us have a management system that either equals or exceeds Jadestone's own management system
- Manage and maintain plant, equipment and machinery to achieve required performance, safety and integrity
- Openly monitor, evaluate and report HSE performance, and communicate to all relevant stakeholders, and
- Comply with all regulatory requirements as an absolute minimum.

RESPONSIBILITY

Everyone who is engaged to work for Jadestone shall be familiar with this policy and its contents.

Everyone must take responsibility for ensuring their own safety, the safety of those around them, and the protection of the environment, by following Jadestone's policies and procedures. That includes taking all necessary precautions and immediately acting upon and reporting any HSE concerns they may have.

Everyone has the right to stop the job and a responsibility to intervene in work fronts or activities if they feel there is a risk to themselves, their workmates or to the environment.

A. Paul Blakeley OBE
President & Chief Executive Officer

April 2020

Figure 1-3: Jadestone Energy's HSE Policy (April 2020)

Ecologically Sustainable Development

Australia has developed a National Strategy for Ecologically Sustainable Development (ESD) (available at https://www.environment.gov.au/about-us/esd/publications/national-esd-strategy-part1), which identifies four principles and ways to apply them to a range of industry sectors and issues such as climate change, biodiversity conservation, urban development, employment, and economic activity, diversity and resilience. OPGGS(E) Regulation 3 states that any petroleum activity carried out in an offshore area is carried out in a manner consistent with the principles of ESD as set out in section 3A of the EPBC Act. These are listed below:

a. Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
b. If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
c. Principle of inter-generational equity: that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
d. The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making, and
e. Improved valuation, pricing and incentive mechanisms should be promoted.

Jadestone Energy has incorporated the principles of ESD into the decision-making framework described in Section 5 and in the development of control measures and environmental performance outcomes (EPO) proposed in Sections 5 and 6. Jadestone Energy believes that the commitments made within this EP demonstrate that the environmental management of the activity will be conducted in accordance of the principles of ESD.

Australia is signatory to several international environmental protection agreements and conventions which are relevant to the region, including for the protection of wetlands and environmental values. Australia is also a signatory to several international conventions of potential relevance to the activity, including:

- Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone (AFZ) and Continental Shelf – 1974 (Memorandum of Understanding Box);
- Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention);
- International Convention on Oil Pollution Preparedness, Response and Co-operation 1990;
- Protocol to International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1996;
- Marine Pollution - International Convention for the Prevention of Pollution from Ships (MARPOL); and
- United Nations Convention on the Law of the Sea 1982.

1.7 This Environment Plan

The Stag Facility 50H and 51H Drilling Environment Plan (this EP hereafter) has been prepared in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations) under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and as administered by NOPSEMA.

The objectives of this EP are to ensure that:

- All activities associated with the Activity are planned and conducted in accordance with Jadestone Energy's Health, Safety and Environmental (HSE) Policy (Figure 1-3);

- Potential adverse environmental impacts and risks associated with the proposed activities, during both routine and non-routine operations, are continually reduced to as low as reasonably practicable (ALARP) and of acceptable levels; and
- That the environmental performance outcomes (EPO) and environmental performance standards (EPS) outlined in this EP are met.

This EP contains the environmental impact assessment for the activity. The assessment aims to systematically identify and assess the potential environmental impacts and risks associated with the activity and to stipulate mitigation measures to avoid and/or reduce any adverse impacts to the marine environment to ALARP and acceptable levels. The implementation of the EPOs specified within this document will provide Jadestone Energy with the required level of assurance that the activities are being managed in an environmentally responsible manner.

NOPSEMA's Guidance Note for Environment Plan Content Requirements (GN-1344; Rev 4, April 2019) was referred to in the preparation of this EP.

2. DESCRIPTION OF THE ACTIVITY

2.1 Planned Activity Summary

This EP includes the following MODU-based activities to be completed at the Stag platform:

- Mobilise MODU to Operational Area
- Plug and abandonment (P&A) of existing producer wells (38H and 44H)
- Drill two new production wells (50H and 51H)
- Demobilise MODU from Operational Area

Further detail on the proposed drilling activities is provided below.

2.1.1 Mobilisation and De-mobilisation of MODU

<u>Mobilisation</u>

- Move rig to Operational Area;
- Soft pin MODU using spud cans (three, each covering a surface area of approximately 260 m^2);
- Use anchor handling tug supply vessels (typically 3) to locate MODU at final position);
- Pre-load rig including uptake of ballast to pre-load tanks;
- Dump ballast and jack up; and
- Establish interfaces with Stag CPF.

<u>Demobilisation</u>

- Jack down MODU; and
- Tow rig out of Operational Area.

2.1.2 Plug and Abandonment of Stag 38-H

Stag-38H, an existing oil producer well, will be abandoned with the existing tubing string recovered from the well. A series of cement plugs will be set within the wellbore to isolate the reservoir from the environment and casing strings will be cut and recovered from below the seabed. Cement plug integrity will be verified in accordance with Jadestone's Well Engineering Standards (JS-50-STD-W-00001).

The existing 762 mm conductor is not planned to be recovered, instead a new inner 508 mm conductor will be run within the 762 mm conductor to facilitate drilling Stag-50H.

A summary of the activities has been provided in Table 2-1.

Table 2-1: Summary of P&A activities to be completed at 38-H

Operation
1. Mobilisation
2. Nipple up blow out preventers (BOPs) and riser
3. Well kill
4. Recover upper completion
5. Set cement plug #1
6. Verify cement plug #1 and set cement plug #2
7. Verify cement plug #2 and cut 244 mm casing
8. Nipple down BOP, Spool tree and wellhead B section
9. Recover 244 mm casing.
10. Cut and recover 340 mm casing
11. Recover A Section wellhead
12. Cut and recover 508 mm casing with whipstock.

Note: As many operations as possible will be conducted with the Hydraulic Workover Unit (under the existing Stag Operations EP (GF-70-PLN-I-00002) prior to the arrival of the MODU.

2.1.3 Drill Production Well Stag 50-H

Stag 50H will be drilled as a production well from the Stag CPF, in the slot recovered through the abandonment of Stag-38H.

A new 508 mm conductor will be run and grouted in place. The top-hole section of the well will be drilled with seawater and bentonite sweeps through the conductor with fluid and cuttings discharged direct to the sea. On reaching section target depth (TD), the drill string will be retrieved from the hole and surface casing shall be run in the hole. The surface casing will be cemented. After cementing of the surface casing, a well head will be installed at surface (at the mezzanine level of the Stag CPF) and a high-pressure riser and blow-out preventer (BOP) will then be installed on the wellhead. The BOP will be function and pressure tested on initial installation and at regular intervals thereafter.

The first intermediate hole section will then be directionally drilled with WBM above the reservoir with a closed fluid system, that is, drilling fluid complete with cuttings will be returned to the rig for processing with the cuttings removed from the drilling fluid via the shale shakers and discharged overboard; cleaned mud is returned to the mud tanks for reuse. At section TD, the drill string will be retrieved and the relevant casing string run in the hole. The casing will be cemented and the Christmas tree installed on to the wellhead.

The second intermediate hole section will then be directionally drilled with WBM just into the reservoir with a closed fluid system. At section TD, the drill string will be retrieved and the relevant casing string run in the hole. The casing will be cemented.

The production hole section will then be drilled horizontally through the reservoir with WBM with a closed fluid system. At section TD, the drill string will be retrieved and sand screens will be run in the hole.

In the event the reservoir has been swept of oil, a side track may be drilled. In this instance, the well will be plugged back to the surface casing shoe and the intermediate and production hole sections shall be redrilled as per the process described above targeting a different section of the reservoir (refer Section 2.2.7).

Wireline logging may be undertaken during the time of drilling and completing the wells.

The upper completion will then be run and installed in the well and the well will then be connected directly to the Stag production process.

A summary of the activities to be completed in drilling Stag 50-H has been provided below:

- Installation of new conductor (508 mm);
- Commence drilling of top hole section, setting and cementing surface casing (340 mm);
- Installation of blow-out preventers (BOPs);
- Drilling of intermediate well intervals using water-based mud (WBM), including setting and cementing intermediate casing strings (244 mm and 178 mm);
- Drilling of production interval through the reservoir using WBM, including installation of lower completion (114 mm) (sand screens);
- Contingency drilling using Loss Circulation Materials as required; and
- Installation of upper completion (114 mm tubing).

2.1.4 Plug and Abandonment of Stag 44-H

Stag-44H, an existing oil producer well, will be abandoned with the existing tubing string recovered from the well. A series of cement plugs will be set within the wellbore to isolate the reservoir from the environment and casing strings will be cut and recovered from below the seabed. Cement plug integrity will be verified in accordance with Jadestone's Well Engineering Standards (JS-50-STD-W-00001).

If the 340 mm casing is in good condition, a whipstock will be set and Stag-51H will be drilled and completed after sidetracking successfully from the 340 mm casing. If the 340 mm casing is in bad condition, it will be cut and recovered along with the 473 mm casing and 762 mm conductor.

A summary of the activities has been provided in Table 2-2.

Table 2-2: Summary of P&A activities to be completed at 44-H

Operation
1. Mobilisation
2. Nipple up BOPs and riser
3. Well kill
4. Recover upper completion
5. Set cement plug #1
6. Verify cement plug #1 and set cement plug #2
7. Verify cement plug #2 and cut 244 mm casing
8. Nipple down BOP, Spool tree and wellhead B section
9. Recover 244 mm casing.
10. If 340 mm casing in bad condition for future sidetrack: Cut and recover 340 mm casing
11. If 340 mm casing in bad condition for future sidetrack: Recover A Section wellhead

12. If 340 mm casing in bad condition for future sidetrack: Cut and recover 473 mm casing.
13. If 340 mm casing in bad condition for future sidetrack: Recover 762 mm casing.

Note: As many operations as possible will be conducted with the Hydraulic Workover Unit (under the existing Stag Operations EP (GF-70-PLN-I-00002) prior to the arrival of the MODU.

2.1.5 Drill Production Well Stag 51-H

Stag 51H will be drilled as a production well from the Stag CPF, in the slot recovered through the abandonment of Stag-44H.

<u>If the 340mm casing is in good condition</u>

A whipstock will be set in the 340 mm casing and the first intermediate hole section will then be sidetracked and directionally drilled with WBM above the reservoir with a closed fluid system, that is, BOP installed. At section TD, the drill string will be retrieved and the relevant casing string run in the hole. The casing will be cemented and the Christmas tree installed on to the wellhead.

The second intermediate hole section will then be directionally drilled with WBM just into the reservoir with a closed fluid system. At section TD, the drill string will be retrieved and the relevant casing string run in the hole. The casing will be cemented.

The production hole section will then be drilled horizontally through the reservoir with WBM with a closed fluid system. At section TD, the drill string will be retrieved and sand screens will be run in the hole.

<u>If the 340mm casing is in bad condition</u>

A new 762 mm conductor will be run and set in place, followed by a 473 mm scab liner. The top-hole section of the well will be drilled with seawater and bentonite sweeps through the conductor and scab liner with fluid and cuttings discharged direct to the sea. On reaching section TD, the drill string will be retrieved from the hole and surface casing shall be run in the hole and cemented. After cementing of the surface casing, a well head will be installed at surface (at the mezzanine level of the Stag CPF) and a high-pressure riser and BOP will then be installed on the wellhead. The BOP will be function and pressure tested on initial installation and at regular intervals thereafter.

The first intermediate hole section will then be directionally drilled with WBM above the reservoir with a closed fluid system. At section TD, the drill string will be retrieved and the relevant casing string run in the hole. The casing will be cemented and the Christmas tree installed on to the wellhead.

The second intermediate hole section will then be directionally drilled with WBM just into the reservoir with a closed fluid system. At section TD, the drill string will be retrieved and the relevant casing string run in the hole and cemented.

The production hole section will then be drilled horizontally through the reservoir with WBM with a closed fluid system. At section TD, the drill string will be retrieved and sand screens will be run in the hole.

In the event the reservoir has been swept of oil, a side track may be drilled. In this instance, the well will be plugged back to the surface casing shoe and the intermediate and production hole sections shall be redrilled as per the process described above targeting a different section of the reservoir (Section 2.2.7).

Wireline logging may be undertaken during the time of drilling and completing the wells.

The upper completion will then be run and installed in the well and the well will then be connected directly to the Stag production process.

A summary of the activities to be completed in drilling Stag 51-H has been provided below:

- If the 340 mm casing is in good condition:

- Installation of blow-out preventers (BOPs);
- Setting of whipstock in 340 mm casing and commence drilling of intermediate well intervals using WBM, including setting and cementing intermediate casing strings (244 mm and 178 mm);
- Drilling of production interval through the reservoir using WBM, including installation of lower completion (114 mm) (sand screens);
- Contingency drilling using Loss Circulation Materials as required; and
- Installation of upper completion (114 mm tubing).

- If the 340 mm casing is in bad condition:
  - Installation of new conductor (762 mm);
  - Installation of scab liner (473 mm);
  - Commence drilling of top hole section, setting and cementing surface casing (340 mm);
  - Installation of blow-out preventers (BOPs);
  - Drilling of intermediate well intervals using WBM, including setting and cementing intermediate casing strings (244 mm and 178 mm);
  - Drilling of production interval through the reservoir using WBM, including installation of lower completion (114 mm) (sand screens);
  - Contingency drilling using Loss Circulation Materials as required; and
  - Installation of upper completion (114 mm tubing).

2.2 Drilling Discharges

Planned drilling discharges include:

- Drill cuttings;
- Brine;
- Water based muds;
- Dry bulks; and
- Wet cement.

A description of each discharge is provided in the sub-sections below.

2.2.1 Drilling Fluid Selection

Drilling fluids fulfil many functions with the most important being:

- Remove drilled cuttings from under the drill bit and transport the cuttings out of the hole;
- Suspend cuttings in the fluid when circulation is stopped;
- Release cuttings when processed by surface equipment;
- Provide enough hydrostatic pressure to balance formation pore pressures and prevent the bore hole from collapsing or caving in;
- Protect producing formations from damage which could impair production; and
- Clean, cool, and lubricate the drill bit.

2.2.2 Cement

Cement is used to form permanent barriers and fix casings in place. It may also be used to seal a lost circulation zone, and when abandoning the well.

The majority of cement will remain downhole although minor volumes will be discharged at the mudline (seabed surface), and at sea surface.

A small amount of cement will be discharged at the seabed during installation of the conductor, and excess cement will be discharged at the end of the campaign (slurry and surplus dry cement).

2.2.3 Top Hole Section(s)

Top hole section(s) will be drilled with seawater and pre-hydrated (bentonite) gel (PHG) sweeps with returns of both drilling fluid and cuttings being direct to the environment. Upon reaching TD the hole will be circulated clean and displaced to PHG.

2.2.4 Intermediate Hole Section(s)

Intermediate hole section(s) will be drilled with a polymer WBM. The WBM shall typically consist of between 92–98% fresh or saline water. The remaining 2–8% of the WBM is made up of drilling fluid additives that are either completely inert in the marine environment, naturally occurring benign minerals, readily biodegradable organic polymers with a fast rate of biodegradation in the marine environment or products in low concentrations with a very low potential for environmental impact.

The same mud will be utilised for all intermediate hole sections.

If the residual intermediate hole section drilling fluid can be used for drilling the reservoir section(s), they will be retained and reformulated; however, if they are not suitable for use they will be discharged to sea.

2.2.5 Reservoir Hole Section(s)

Reservoir hole section(s) will be drilled with a water-based drill-in fluid mud (WBM). The drill-in fluid is formulated to be non-damaging to the reservoir and minimise losses with the reservoir through the bridging of pore throats with sized calcium carbonate. The WBM typically consists of between 92–98% fresh or saline water. The remaining 2–8% of the WBM is made up of drilling fluid additives that are either completely inert in the marine environment, naturally occurring benign minerals, readily biodegradable organic polymers with a fast rate of biodegradation in the marine environment or products in low concentrations with a very low potential for environmental impact.

On completion of the reservoir hole section, residual mud will be discharged overboard in a single event.

2.2.6 Cuttings

Cuttings will be removed at surface from the recirculating mud by shale shakers, desanders, desilters (and centrifuges for very fine particles if required). The solids removed from the mud are discharged overboard. Some components of the drilling fluid will remain adhered to the discharged drill cuttings.

Cuttings will be discharged to sea surface, or may be discharged just under the sea surface (a couple of metres) using a discharge pipe (depending on the selected MODU).

2.2.7 Side Track

In the event the drilling target is reached and the area is found to have been swept (i.e. there is inadequate oil present to meet production requirements) a second drill target may be reached with a side track. The side track will commence from below the 340mm surface casing and therefore the side track activity will be a repeat of the intermediate and reservoir hole section descriptions provided above.

2.2.8 Discharge Volumes

During the drilling of each well, approximately 400m^3 of seawater/PHG and WBM fluids will be discharged per well, and cuttings volumes are estimated at 200m^3 per well. In addition to this, discharges will occur when changing from drilling muds to completion fluids (discharge of up to one mud pit which is approximately 80m^3), during wellbore cleanup and at the end of each well. Further discharge may occur if sidetracking is required. Therefore, an estimation of approximately 1600m^3 of seawater/PHG and WBM may be discharged per well, this is based on recent wells drilled at Stag.

During drilling, small volumes of cement will be discharged at the seabed, and excess cement will be discharged at the end of the campaign. Unused cement slurry is discharged from the cement unit at surface on completion of each cement job (approximately 1-2 m^3). At end of the 50-H and 51-H drilling activity, waste cement (approximately 40 – 50 m^3 surplus dry cement) will be blown overboard.

For noting, no discharges are proposed for the P&A of wells Stag 38-H and 44-H other than some cement (approximately 4 m^3) that will be extruded at the mudline during isolation of the wellbore (refer Section 2.1.2).

2.3 Well Control

Jadestone ensures control of its wells through a number of control measures incorporated into well design, drilling procedures, mud selection, personnel training and equipment maintenance and testing. Wells are drilled in accordance with Jadestone's Well Engineering Standards (JS-50-STD-W-00001) and a NOPSEMA accepted Well Operations Management Plan (WOMP).

When applicable, BOPs are installed to ensure that wells will have sufficient barriers maintained during drilling, suspension and abandonment activities in accordance with the Jadestone's Well Engineering Standards (JS-50-STD-W-00001). All well control equipment, casings and wellhead equipment is tested to maximum anticipated surface pressure (MASP) in accordance with the same standard.

2.4 Well Testing

No well testing will be conducted as part of this activity.

2.5 Well Logging

Logging will be conducted during drilling activities. Logging is a continuous measurement of formation properties. Measurements can include drilling parameters, geological sampling, electrical and sonic properties, active and passive nuclear measurements, dimensional measurements of the wellbore, formation fluid sampling, formation pressure measurement, and others.

2.6 Schedule

Approximately 90 days is expected to complete the P&As and new production wells activities at the Stag platform. While the timing of the drilling activities will be a function of rig availability, the preferred timing will be between June and October of 2022, however the activities may occur outside of this window, and may occur in 2023. For this reason, it is intended that this EP will remain valid until the end of 2023.

2.7 Mobile Offshore Drilling Unit

Well activities will be undertaken by a jack-up drilling rig. At the time of EP preparation, the drilling rig had not been confirmed however the MODU engaged will undertake the activities in accordance with Jadestone Energy's environmental specifications including those outlined in this EP.

Jack-up rigs are towed into position at the drilling location by three support vessels. Once at the desired location and with the rig stationary, the legs are lowered to be fully in contact with the seabed and the rig raises itself above the sea surface, supported by three legs contacting the sea floor. There are three spudcans that will penetrate the seabed each with a diameter of approximately 18 m. The estimated surface area at the bottom of each leg and associated spud can is 260 m^2. The final location of the spudcans is as close to previous spud can depressions as possible to minimise instability.

No anchoring is required for the MODU during this activity.

2.8 Operational Area

The Operational Area is defined as the area within a 500m radius that extends around the tophole location of the well activity, which is at the Stag CPF. This EP covers four activities:

- Plug and abandonment of 38-H production well;
- Drilling of new production well 50-H;
- Plug and abandonment of 44-H production well;
- Drilling of new production well 51-H;

The locations for the drilling activities described are provided in Table 2-3.

Table 2-3: Tophole locations for the drilling activities

Activity	Latitude	Longitude
P&A of production well 38-H	20° 17' 24.021 S	116° 16' 31.059 E
Drilling of production well 50-H		
P&A of production well 44-H	20° 17' 23.964 S	116° 16' 31.025 E
Drilling of production well 51-H		

2.9 Existing Facility

Jadestone is the titleholder of the Stag Facility in permit WA-15-L (Figure 1-2). The facility consists of:

- The CPF, producing and processing oil from a series of wells;
- A single 2 km long carbon steel export oil pipeline on the northeast side of the CPF connecting to a Catenary Anchor Leg Mooring (CALM) buoy;
- A third-party tanker receives oil through a flexible offtake hose from the CALM buoy. Once loading is complete, the tanker departs the field for delivery of cargo to market. No offtake activity from the third party tanker occurs in field;
- Water injection flowlines and wells to assist reservoir fluid recovery;
- Support/ supply vessels, work vessels and tug boats/static tow vessels supporting third-party tanker movement, facility logistics, maintenance and provisioning; and
- Helicopter support.

The facility has been in production since 1998 and only minor modifications have been carried out since this time.

There is a restricted zone of 500 m radius around the CPF, CALM buoy and pipeline and third-party tanker (whilst at mooring). Vessels operating within this zone must not exceed a speed of five (5) knots. There is also a cautionary area circle as designated by the Australian Maritime Safety Authority (AMSA) of 3 nautical miles' radius charted around the Stag Field facilities, with the centre located 1,365 m due north of the CPF. This location is arranged such that the limits of the circle sweep out by the third-party offtake tanker and support vessel at the same distance from the edge of the cautionary area as the CPF.

2.10 Interface with Stag CPF

When the MODU is operating at the CPF, all operations are coordinated through a drilling specific Simultaneous Operations (SIMOPS) plan. This plan directs the proposed activities and requirements to occur in parallel with production operations activities. Central to this is the Matrix of Permitted Operations (MOPO), which maps out the production shut downs and required isolations during drilling operations.

All rig activities are consistent with the Stag Operations Well Operations Management Plan (WOMP) (GF-50-PLN-W-00001) and MODU Safety Case and revision.

2.11 Fuel and Chemicals

The main engines and equipment used on the MODU (e.g. pumps, cranes, winches, power packs, generators), and support vessels require marine diesel for fuel, hydraulic fluid and lubricating oils for operation and maintenance of moving parts. Main engines store hydrocarbons in independent storage tanks and drums of fuel and oil are kept in storage areas.

Other hazardous liquids used during the drilling activities include biocides, corrosion inhibitors, fluid loss control chemicals and miscellaneous chemicals (including pipe dope, lubricating oils, cleaning and cooling agents, oily water, cement, recovered solvents, stored or spent chemicals, used lubricating oils).

Chemicals used and discharged in drilling operations must be Chemical Hazard and Risk Management (CHARM) rated Gold or Silver or have an Offshore Chemical Notification Scheme (OCNS) rating of D or E. Where proposed chemicals do not meet this selection criteria, alternatives will be sought. Chemicals with substitution warnings are also considered to find alternatives where feasible. If no alternative is available, or a CHARM or OCNS rating is not available, a risk assessment will be conducted according to Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033). To achieve these rankings, the chemicals have the least potential for environmental impact.

Chemicals and hydrocarbons will be packaged, marked, labelled and stowed in accordance with MARPOL Annex I, II and III regulations. Specifically, all chemicals (environmentally hazardous) and hydrocarbons will be stored in closed, secure and appropriately bunded areas.

In the event vessels supporting the drilling activities require refuelling, the vessels will refuel in Dampier.

2.12 Operational Discharges

Operational discharges from the MODU and support vessels will include:

- Deck drainage;
- Putrescible waste and sewage;
- Oily water;
- Cooling water from operation of engines;
- Desalination plant effluent (brine) and backwash water discharge; and
- Ballast water.

An overview of each category is provided below. Further information on drilling discharges associated with the activities is provided in Section 6.5. For further information on operational discharges, refer to Section 6.4.

2.12.1 Deck Drainage

During the activity, the vessels and MODU may receive rainfall on deck. Contaminants on the deck surface will be in trace quantities and will comprise contaminants such as detergents, and oil and grease.

2.12.2 Putrescible Waste and Sewage

The volume of sewage and food waste is directly proportional to the number of persons onboard the MODU and support vessels. Approximately 30-40 L of sewage/ grey water will be generated per person per day. Putrescible waste will consist of approximately 1 L of food waste per person per day.

2.12.3 Oily Water

Bilge water is an almost unavoidable product in vessel operations. Bilge water that is generated in proximity to shipboard equipment (such as in the engine room) may contain residual hydrocarbons. Bunded spaces around machinery may also contain oily water. Oily water will be directed to a bilge water tank, treated and released to marine waters.

2.12.4 Cooling Water from Operation of Engines

Seawater is used as a heat exchange medium for the cooling of machinery engines. Seawater is drawn from the ocean and flows counter current through closed-circuit heat exchangers, transferring heat from engines and machinery to the seawater. The seawater is then discharged to the ocean (i.e. it is a once-through system).

2.12.5 Desalination Plant Effluent (Brine) and Backwash Water Discharge

Effluent from the water supply systems onboard the MODU and support vessels will be discharged to the ocean at a salinity concentration higher than seawater. The volume of the discharge is dependent on the requirement for fresh (or potable) water and would vary between the vessels and the number of people onboard.

The effluent may contain scale inhibitors that control inorganic scale formation, such as the formation of calcium carbonate and magnesium hydroxide, in water making plants. Other water purification chemicals (e.g. chlorine) may be added to the potable water. Other water making plant cleaning chemicals may be used and discharged to sea after completion of the cleaning process.

2.12.6 Ballast Water

When at location, support vessels will take on ballast water to allow for safe discharge of deck cargo and/ or bulk products (liquid or dry). In the event support vessels need to take on liquid cargo from the MODU, it is expected that vessels will need to discharge ballast water. Similarly, in mobilisation and demobilisation activities at the Stag CPF, the MODU will need to exchange ballast water and seawater.

2.13 Emissions

Light, noise and gases will be emitted to the environment during the drilling activities.

As the drilling activities will be continuous 24 hour operations, light will be continuously emitted from the MODU to the environment for approximately 90 days.

Noise associated with the operation of machinery and engines will be generated by the MODU and support vessels. No vertical seismic profiling or side scan sonar will be undertaken during the drilling activities.

Gaseous emissions will be made to the environment due to the combustion of hydrocarbons during the operation of equipment and machinery on the MODU and support vessels for the duration of the drilling activities. No flaring will occur associated with the drilling activities.

For further information on light, noise and atmospheric emissions made during the drilling activities, refer to Sections 6.1, 6.2 and 6.3, respectively.

2.14 ROV Operations

Remotely operated vehicle (ROV) surveys are likely to occur periodically to determine the condition of the seabed and to monitor drilling operations, as well as manipulate subsea equipment, and confirm site adequacy.

2.15 Vessel Operations

The MODU will be assisted by typically 3 vessels during MODU positioning, and 1-2 for drilling support. Support vessels to be used during the drilling activities will be sourced from Dampier and local NW ports wherever possible, and will not anchor in the operational area during the activity.

Support vessels will transfer supplies to the MODU and receive waste and excess materials while on location.

Supplies to the MODU include bulks, fuel, and material and equipment required for operations and drilling purposes. Such material and equipment includes bins, baskets, containers and tubulars. Bulk products will also be transferred via hose from/ to the vessels and MODU. Such products include marine diesel, drilling fluids, brine, drilling water and cement.

The MODU will back-load equipment and wastes to the vessels for return to shore for reuse and/ or disposal, either back to the supplier or to an approved waste facility. The support vessels will generally operate between the MODU and Dampier Port.

The MODU and support vessels have marine VHF and satellite phones to maintain communications with each other, the CPF and other marine users.

2.16 Helicopter Operations

Crew changes for personnel aboard the MODU will involve transfer by helicopter between the MODU and the regional airport at Karratha. These flights will occur several times a week dependent on the progress of the drilling program and logistical constraints.

3. DESCRIPTION OF THE ENVIRONMENT

OPGGS(E) Regulation 13(2) requires the proponent to '(a) describe the existing environment that may be affected by the activity; and (b) include details of the particular relevant values and sensitivities (if any) of that environment.'

To address this requirement, Jadestone has evaluated the values and sensitivities within two types of areas related to the activity:

- The Operational Area – the geographical area encompassing the environment that may be affected by the planned activities (Section 2.8); and
- The Environment that May Be Affected (EMBA) – the geographical area encompassing the environment that has the potential to be affected by the unplanned events associated with the activities described (Section 2) depending upon the level of exposure.

The spatial extent of the EMBA and location of the Operational Area is presented in Figure 3-1. The EMBA is based on the low-level exposure of hydrocarbons on and in, the water and represents the largest extent of an oil spill due to the worst-case scenario as per NOPSEMA Bulletin #1. This is further described in Appendix D and below:

- Surface hydrocarbons EMBA– hydrocarbons that are 'on' the water surface (>1 g/m^2)
- Entrained hydrocarbons EMBA– hydrocarbon that is entrained 'in' the water (>10 ppb)
- Dissolved hydrocarbons EMBA– the dissolved component of hydrocarbon in' the water (>10 ppb), and
- Shoreline loading EMBA – hydrocarbons greater than 10 g/m^2.

Details of the environmental values and sensitivities in the Operational Area are described here in Section 3. The environmental values and sensitivities in the EMBA have been used to inform the assessment of the unplanned events in particular, crude and marine diesel spills, oil spill response planning and oil spill risk assessment (Section 6.8, 7.5 and 7.6). A full list of the environmental values and sensitivities in the EMBA is contained in Appendix B.

A number of spill scenarios have been modelled and the EMBA represents the worst case for all of the spills rather than the worst case of a single spill. Within the EMBA is a smaller RISK EMBA which is represented by higher thresholds (termed as 'moderate' in NOPSEMA bulletin #1), this represents the environment within which receptors could be affected (rather than just contacted) and is based on scientific knowledge to determine the potential for impact. This is further described in Section 7.5. All the receptors within the RISK EMBA are contained within the EMBA and therefore fully described within this chapter.

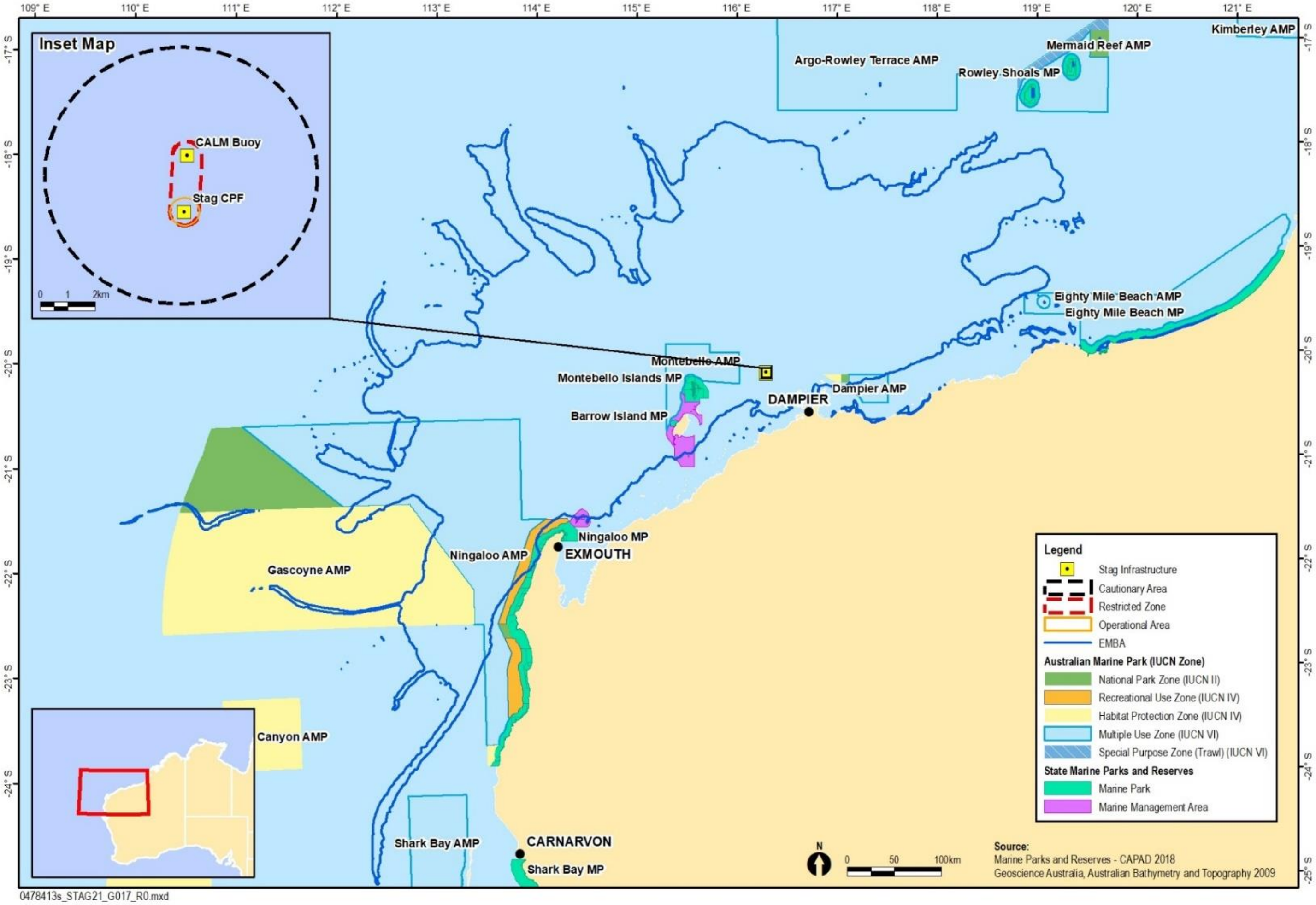

Figure 3-1: Annualised EMBA for Worst Case Scenario Hydrocarbon Spill

3.1 Regional Setting

The Operational Area and EMBA lie entirely within the Commonwealth waters of the North-west Marine Region (the region) and adjacent state waters between Ningaloo and Eighty Mile Beach. The region is distinguished by its predominantly wide continental shelf, very high tidal regimes (especially in the north), high cyclone incidence, unique current systems and warm, low-nutrient surface waters.

The region supports high species-richness of tropical Indo-west Pacific biota, but low levels of endemism (DSEWPaC 2012d). The offshore islands, coastline and waters within the region provide vital habitat to an extensive range of marine species including turtles, cetaceans, whale sharks and seabirds and has high fish biodiversity and consequently, is of value to commercial fish, prawn and crab fisheries.

3.2 Physical Environment

3.2.1 Climate

The region lies in the arid tropics experiencing high summer temperatures and periodic cyclones. Rainfall in the region is low with evaporation generally exceeding rainfall throughout the year although intense rainfall may occur during the passage of summer tropical cyclones and thunderstorms (Condie et al. 2006). Mean air temperatures over the neighbouring ocean area range from a minimum of 11°C in winter to a maximum of 37°C in summer. Due to the arid climate, daytime visibility in the area is generally greater than 5 nm (SSE 1991).

The summer and winter seasons fall into the periods September–March and May–July, respectively. Winters are characterised by clear skies, fine weather, predominantly strong east to south-east winds and infrequent rain. Summer winds are more variable, with strong south-westerlies dominating. Three to four cyclones per year are typical, with the official cyclone season being November through to April (BoM 2013).

3.2.2 Seawater Temperature and Salinity

Salinity is relatively uniform at 34–35 ppt throughout the water column and across the NWS. Due to the low rainfall, there is little freshwater run-off from the adjacent mainland (Blaber et al. 1985). NWS waters are usually thermally stratified, with a marked change in water density at approximately 20 m (SSE 1993). Surface temperatures vary annually, being warmest in March (32°C) and coolest in August (19°C). Vertical gradients are correlated to sea surface temperatures and are greatest during the warm-water season (SSE 1991). Near bottom water temperature is approximately 23°C with no discernible seasonal variation.

Changes in water temperature and salinity characteristics can result from changes in local heating and evaporation following the southward movement of warmer water due to southward-moving cyclones and can have flow-on effects to primary and secondary productivity (McKinnon et al. 2003).

3.2.3 Wind

Non-cyclonic wind conditions are predicted for the Stag Field based on four years of continuous wind measurements at a nearby site (Wandoo platform; WNI 1995). Wind patterns are monsoonal with a marked seasonal pattern; wind shear on surface waters generates local-scale drift currents that can persist for extended periods (hours to days). During October–March, the prevailing non-storm winds are from the south-west, west and north-west at an average speed of less than 10 knots, peak average speeds of 15– 25 knots, and maximum speeds of 30 knots. Winds from the south-east to north-east quadrant are experienced at a frequency of less than 10% over these seasons. In June–August, winds are generally lighter and more variable in direction than in spring and summer. Non-storm winds prevail from north-east through to south-east at average speeds of 5–6 knots, peak average speeds of 10–15 knots, and maximum speeds of 20 knots. Transitional wind periods, during which either seasonal wind pattern may predominate, can be experienced in April–May and September of each year.

Extreme wind conditions in the area may be generated by tropical cyclones, strong easterly pressure gradients, squalls, tornados and waterspouts. Tropical cyclones generate the most significant storm conditions on the NWS (SSE 1993). These clockwise-spiralling storms have generated wind speeds 50–120 knots within the region (SSE 1991). Tropical cyclones develop in the eastern Indian Ocean, and the Timor and Arafura Seas during the summer months of November to April. Since recordings began in 1960/61, tropical cyclones have approached from the northwest through to east, with the most frequent directions being from the north (34%) and east (36%). Due to the circular wind patterns involved however, winds can approach from any direction during the passage of the storm.

3.2.4 Waves

The wave climate is composed of locally generated wind waves (seas) and swells that are propagated from distant areas (WNI 1995). Sea directions run roughly parallel to prevailing wind directions. Hence, in summer, seas typically approach from the west and south-west, while in winter, seas typically approach from the south and east. Mean sea wave heights of less than 1 m with peak heights of less than 2 m are experienced in all months of the year (WNI 1995). Mean swell heights are low at around 0.4–0.6 m in all months. Due to the proximity of the mainland, the greatest exposure to swells is from the west (SSE 1993). Tropical cyclones have generated significant swell heights of up to 5 m in this area, although the predicted frequency of swells exceeding 2 m is less than 5% (WNI 1996). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway and Nye 1985).

3.2.5 Tides and Currents

Sea surface currents over the NWS are generated by several components such as tidal forcing, local wind forcing and residual drift. Of these, tidal and wind forcing are the dominant contributions to local sea surface currents. The orientation and degree of drop-off of the continental shelf slope also influences the oceanography of the area. The tides of the NWS have a strong semi-diurnal signal with four tide changes per day (Holloway and Nye 1985; CMAR 2007). Peak tidal flows are from the north-northwest on the ebb, and to the south-southeast on the flood (Holloway and Nye 1985; SSE 1993; King 1994). Mid-shelf tidal currents are predicted to have average speeds of approximately 0.25 knots during neap tides and up to 0.5 knots during spring tides (NSR 1995; WNI 1995).

The dominant offshore sea surface current (typically seaward of the 200m isobath) is the Leeuwin Current (Figure 3-2), which carries warm tropical water south along the edge of WA's continental shelf, reaching its peak strength in winter and becoming weaker and more variable in summer (CMAR 2007; Condie et al. 2006). The current is described as a surface current, extending in depth to 150 m (BHPB 2005; Woodside 2005). From September to mid-April the nearshore Ningaloo Current flows northwards, opposite to the Leeuwin Current, along the outside of the Ningaloo Reef and across the inner shelf (BHPB 2005; Woodside 2005). The Indonesian Throughflow is the other important current influencing the upper 200 m of the outer NWS (Woodside 2005; CMAR 2007). This current brings warm and relatively fresh water to the region from the western Pacific via the Indonesian Archipelago. Modelling undertaken by Woodside and CMAR indicates that significant east-west flows occur across the NWS to the north of the North-West Cape, possibly linking water masses in the area (Woodside 2005; Condie et al. 2006).

Offshore drift currents are represented as a series of interconnected eddies and connecting flows that can generate relatively fast (1–2 knots) and complex water movement. These offshore drift currents also tend to persist longer (days to weeks) than tidal current flows (hours between reversals). Therefore, in the event of an accidental oil spill, offshore drift currents have a greater influence than tidal currents on oil dispersion over timescales exceeding a few hours (APASA 2020).

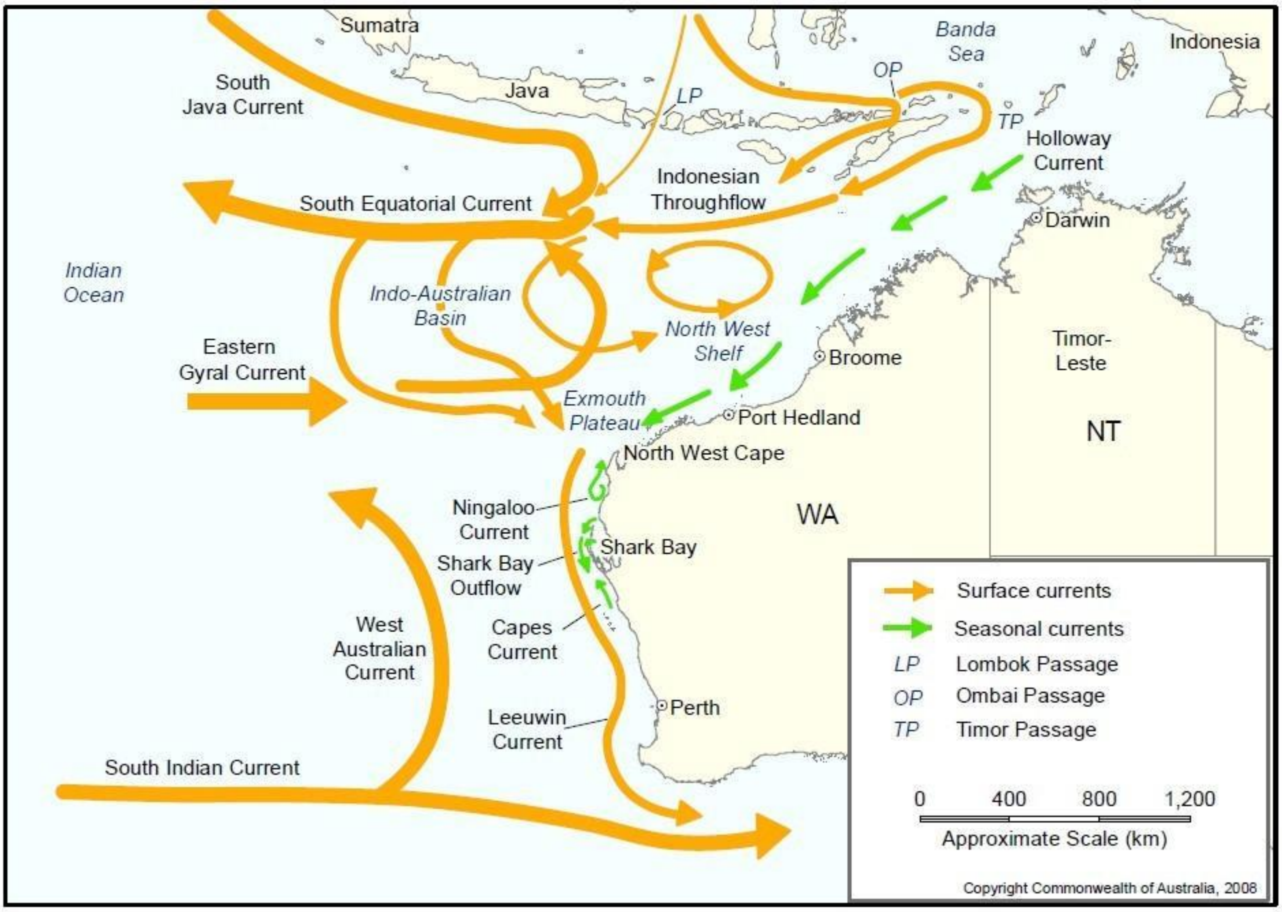

Figure 3-2: Surface Currents of the North-West Marine Region

3.2.6 Sedimentology

The Operational Area is characterised by a thick sequence of carbonate rock that is overlain by thin layers of unconsolidated fine to medium grained, carbonate sediments with occasional shell or gravel patches (Racal, 1994; Dames and Moore, 1995). Surveys conducted over the NWS indicate that a similar seafloor occurs extensively over this geographic region, but with spatial variation in the grain size and origin of the surface sediments (McLoughlin and Young, 1985; Woodside, 1990). Surface seabed sediments in the area are predominantly composed of skeletal remains of marine fauna, with lenses of weathered sands (McLoughlin and Young, 1985).

A debris seabed survey around the Stag Platform was undertaken as part of the Stag Apache Site Survey Campaign 2011 (Neptune Geomatics, 2011b). The survey confirmed that the surrounding seabed is free from debris. Two seabed types have been classified throughout the Operational area:

- Type A: Low relief unconsolidated calcareous fine to medium sand; and
- Type B: Low relief unconsolidated calcareous gravelly medium to coarse sand.

3.3 Subtidal Benthic Habitats

Benthic habitats are defined as those subtidal habitats lying below the lowest astronomical tide (LAT). The benthic habitats within the EMBA range from those at LAT to more than 6,000 m at the canyons linking the Cuvier Abyssal Plain and Cape Range Peninsula (DEWHA 2012).

Benthic habitats are partially driven by light availability. Primary producers (photosynthetic corals, seagrass and macroalgae) are limited to the photic zone, whereas benthic invertebrates including filter feeding communities may be found in deeper waters. The depth of the photic zone varies spatially and temporally is predominantly dependent on the volumes of the suspended material in the water column. The photic zone in the offshore Pilbara approximately 70 m whereas in oceanic waters, the photic zone may extend to 120 m (DEWHA 2008).

3.3.1 Operational Area

3.3.1.2 Baseline Conditions

Apache Energy Ltd conducted sampling of the infauna and sediment characteristics within the Operational Area prior to development drilling as a baseline for comparison to the post-development (Kinhill 1997; 1998). This study confirmed that the benthic biota within the vicinity of Stag is comparable to that found over similar substratum and at similar depths over the wider region (Ward and Rainer 1988; Woodside 1988; Rainer 1991). The unconsolidated sediments in this habitat were found to support a diverse infauna, consisting predominantly of mobile burrowing species, which include molluscs; crustaceans (crabs, shrimps and smaller related species); polychaete, sipunculid and platyhelminth worms; asteroids (sea stars); echinoids (sea urchins), and other small infaunal animals.

Sediment and water quality data within the Operational Area was collected and analysed initially as a baseline study by Kinhill in 1997. The following characteristics were described:

- Water quality: temperature 29.6 –30.7^{o}C at surface and 29.3–29.6^{o}C seabed;
- Salinity 33.3–33.9 ppt;
- Oxygen 4.49 – 6.2 mg/L;
- Organic content 40% sediment;
- Sediment particle size was spatially (and temporally) variable;
- No hydrocarbons in marine sediments;
- Metals (barium, cadmium, chromium, copper, lead and zinc were low (below detection limits);
- Infauna 67.8 individuals/kg.

3.3.1.3 Post Drilling Conditions

There have been a number of studies undertaken after drilling has commenced (including Kinhill 1997, Kinhill 1998, CSIRO 2001, IRC 2001, and Oceanica 2015). Whilst for the most part there has been no changes to some aspects of the sediment and benthic habitat a few trends have been noted.

The sediments within the area of the Stag Facility are dominated by sand sized particles, with medium sand comprising the largest fraction. There were no clear trends in particle size distribution (PSD) with increasing distance from the CPF in sediment samples collected by Oceanica (2015). Most sediment was grey in colour and contains shells and other biota present. The majority of samples taken by Oceanica (2015) had no vegetation present and no obvious odour. This is consistent with results from a survey by CSIRO in 2001 (IRC 2001) who reported unconsolidated fine-medium and medium-coarse sands with patches of coral rubble (CSIRO 2001). Grain size characteristics were compared from sites 50m and 200m from the Stag platform against control sites. No differences were detected (IRC 2000).

The total abundance of benthic invertebrates declined considerably between baseline and post- drilling surveys, the decline was similar among all stations including controls irrespective of distance from well (Kinhill 1999).

There is small spatial variability in the infaunal assemblages (e.g. crustaceans, molluscs, ostracods, bivalves, polychaete worms and amphipods) surrounding the Stag Facility and this is typical of soft sediments in the surrounding areas (IRC 2001, Oceanica 2015). Total infaunal abundance ranged between sites closest and further away from the platform (131 + 39 individuals m^{-2} and 417 + 23 m^{-2} respectively). Polychaete worms and crustaceans were the most dominant infauna (IRC 2001). Any differences in infaunal group abundances were of similar magnitude with control locations. Similar results were obtained in a more contemporary study by Oceanica (2015), who reported prawns, polychaetes, tube polychaetes, amphipods and bryozoans in sediment samples collected.

While there are no significant benthic primary producers (benthic photosynthetic organisms) associated with the soft sediment habitat within the Operational Area, some small patches of algae were found by Oceanica (2015). The subsea infrastructure such as the CPF platform, CALM buoy mooring and the MODU spud cans and legs, are likely to provide attachment points with sufficient light availability for algae as well as other filter feeding organisms (e.g. hydroids, bryozoans and molluscs). ROV footage from July 2020 indicated that the biofouling assemblage observed on the Stag field infrastructure was representative of that which would be expected of any structure immersed for an extended period in the waters in that region (PGM Environment 2021).

Pipelines have been shown to have a high abundance of commercially important fish, including snapper and grouper, as well as the presence of thousands of larval fish and juveniles suggesting the pipelines may actually enhance fish stocks (McLean et al., 2017). Although little is known about the habitat preference of syngnathids and pipefish, it is unlikely that they would occur in the operational area, with research showing a preference for coral reefs in tropical areas (Foster & Vincent 2004; Scales 2010).

Sediment contamination

Studies completed in 2000 (IRC 2001) and 2015 (Oceanica 2015) measured levels of contaminants in sediments at sites close to the Stag CPF and further away. Both these studies reported that concentrations of hydrocarbons were below detection limits at all sites and depths. This is consistent with the pre and post drilling surveys (Kinhill, 1997, Kinhill 1998 and Kinhill 1999) earlier.

Unlike hydrocarbons, some trace metals were above detection limits and some were elevated. Barium concentrations increased between baseline and post- drilling surveys (Kinhill 1999). During the IRC study in 2001:

- Barium concentrations were higher within 50m of the Stag platform and ranged from 76 ppm to 189 ppm. Other locations away from the platform ranged between 10.5 ppm and 45.5 ppm while the control locations had a range of 10.5 ppm and 23 ppm.
- Trace metal concentrations for chromium, copper, lead, and zinc were elevated within 50m of the platform when compared to locations further from the platform and the controls (IRC 2001).
- Cadmium concentrations were below detection limit of 0.2 ppm, while Chromium concentrations ranged from 14 ppm at 500m southwest of the Stag platform to 26.5 ppm at a control site.
- Copper concentrations were generally similar across all locations with values ranging from 4 ppm to 6.5 ppm.
- Lead concentrations were generally below detection (< 2 ppm) with the exception of 4.5 ppm and 5.0 ppm recorded 50m northwest of the Stag platform. (IRC 2001).
- Zinc concentrations were highest at 50m northwest of the stag platform with 23 ppm and 15.5 ppm and 17.0 ppm at two control locations.

A more comprehensive study was undertaken in 2015 (Oceanica 2015) to assess sediment quality and demonstrate that 95% species protection trigger values and sediment ISQG values are met at the boundary of the area of impact. TPH, BTEX and PAH in sediment samples were all below the laboratory LoRs. While there are no ANZECC/ARMCANZ guideline values for TPH and BTEX, PAH concentrations were all below their ANZECC/ARMCANZ ISQG-Low and -High values.

Metal concentrations for all sediment samples were below their respective ANZECC/ARMCANZ ISQG-Low and High values (where available). There were no ANZECC/ARMCANZ guidelines for barium, iron, manganese and strontium but the concentrations away from the produced water discharge point were not substantially different to those further away. Highest concentrations in any one sample for these metals are 370, 10,000, 110 and 4500 mg/kg respectively (Oceanica 2015). Zinc concentrations were elevated in the vicinity of the Stag platform (highest reading 41 mg/kg at 70m away) but decreased to background levels at 250 m from the Stag platform (5.3 mg/kg). This is similar to previous monitoring in 2000 (IRC 2001). Lead and barium concentrations results were similar to those reported in 2000; however, the copper and chromium results were slightly lower than those in 2000.

3.3.2 EMBA

A wide range of benthic habitats occur within the EMBA including benthic primary producer habitats (i.e. photosynthetic organisms) such as macroalgal beds, seagrass meadows and hard corals which are distributed in shallow subtidal and intertidal waters, as well as intertidal water/ shoreline distributed habitats such as mangroves and salt marshes. Benthic primary producers are important components of ecosystems as they provide the source of energy driving food webs and provide shelter for a diverse array of organisms.

Other subtidal habitats within the EMBA include unconsolidated sediment, which is the most common subtidal habitat on the NWS, and rocky substrate (e.g. outcropping limestone pavement). Subtidal rocky substrate typically supports a mosaic benthic community which may comprise benthic primary producers such as macroalgae and hard corals in the photic zone. In deeper waters and/or where light is limited, hard substrate may have a community dominated by habitat-forming filter feeding organisms such as various soft corals, sponges and hydroids.

Other intertidal and shoreline habitats in the EMBA include intertidal sand/mud flats, intertidal rocky reefs, rocky shorelines and sandy beaches. Intertidal mud/sand flats are particularly extensive along the more northerly mainland shorelines of the EMBA, where the tidal range is greatest, and comprise large areas of exposed mud and sand at low tide. These are important foraging habitats for shorebirds, including important migratory species, which consume benthic organisms living in and on these flats. Protected sand/mud flat habitats within the EMBA include the Eighty-Mile Beach Ramsar site (also a proposed Marine Park; refer Section 3.7.4). There are numerous sandy beaches within the EMBA, on both offshore islands and the mainland, that are important nesting sites for a number of protected marine turtle species (refer Section 3.6.4).

Habitat diversity is highest in shallower waters where light availability promotes the occurrence of benthic primary producers, and in areas where hard substrate provides attachment points for a greater diversity of habitat forming organisms. Within the EMBA benthic habitat diversity is therefore highest within waters along the Ningaloo coastline, coastal waters between the Dampier Archipelago and Eighty Mile Beach, shallow waters around offshore islands extending from North-West Cape to Eighty Mile Beach (including Muiron, Thevenard, Montebello/ Barrow/ Lowendal, Dampier Archipelago and Turtle islands) and offshore shoals (e.g. Rowley shoals).

A more detailed description of benthic primary producers within the EMBA is provided in the sections below.

3.3.3 Coral Reefs and Communities

Across the NWS, corals tend to occur in relatively shallow areas with strong currents where water movement provides a constant supply of nutrients and particulate food. Corals occur as extensive reefs, patch reefs, isolated bomboras or in scattered colonies across the limestone pavement that dominates the shallow water areas of the region. They contain photosynthetic unicellular algae called zooxanthellae and are therefore reliant on sunlight for their survival

Corals can be grouped into the following categories:

- Sceleractinian corals (hard corals) – reef-building corals;

- Non-sceleractinian corals (sometimes referred to as calcified soft corals) – generally not considered to be reef-building; and
- Soft corals belonging to the order Alcyonacea – non reef-building.

Coral spawning usually occurs during the months of March and April in two concentrated events each of three to four days' duration, occurring on nocturnal, neap and ebb tides 7 to 10 nights following the full moon. In addition to this main spawning period in autumn, coral recruitment occurs throughout the year, with brooding species implicated. There have also been recent observations inferring broadcast spawning of corals along the NWS in October to November, although this appears to be a minor event relative to the March/April spawning.

Regionally, cyclone damage to corals may be significant (WAM 1993; LDM 1996) through physical disturbance and sedimentation (Heinsohn and Spain 1974; Van Woesik et al. 1991; Stejskal 1992). Bleaching of corals surrounding coastal islands was part of a worldwide phenomenon that has been linked to global warming (Hoegh-Guldberg 1999). Other natural events, such as sedimentation and predation may also contribute to temporal variability of live coral cover. Coral predators such as the crown-of-thorns seastars, *Acanthaster planci*, and the corallivorous gastropods, *Drupella cornus* and *D. rugosa*, have been recorded in the NWS region.

Communities subject to frequent natural perturbation are likely to be either resilient or transient and highly dynamic in terms of cover and distribution (WAM 1993). The ability of such species to recolonise after large-scale natural or human disturbance is also likely to be high, although there is interspecific variation in rate of recovery. Fast-growing Acropora species, for example, can recover from severe damage in a few years whereas slow-growing massive species may take up to 30 years to recover from major damage (WAM 1993).

<u>Dampier Archipelago</u>

The closest coral reefs to the Stag facility are those around the Dampier Archipelago, 32 km southeast of the location (Figure 3-3). Coral communities occur throughout the proposed reserves and together, the shallow intertidal and subtidal reef communities comprise 8% (approximately 18,300 ha) of the major marine habitats. The most diverse coral areas in the proposed reserves are found on the seaward slopes of Delambre Island, Hamersley Shoal, Sailfish Reef, Kendrew Island and north-west Enderby Island. Live coral cover can vary greatly from reef to reef, as indicated by contrasting covers of 10 to 60% on Sailfish Reef and Hamersley Shoal, respectively. The proposed reserves have a high diversity of hard corals, with at least 229 species recorded from Western Australian Museum (WAM) surveys (CALM 2005b).

<u>Montebello/Barrow/Lowendal Islands</u>

Coral reefs surround the Barrow/Lowendal/Montebello Island complex (Figure 3-4), 75–96 km southwest of the Stag Facility. Approximately 6% of the Montebello/Barrow Islands Marine Parks are comprised of shallow intertidal and subtidal reef communities. The best developed of these communities are in the relatively clear water and high energy conditions of the fringing reefs to the west and south-west of the Montebello Islands, at Biggada Reef on the west side of Barrow Island. Coral 'bommies' and patch reefs occur in the more turbid and lower energy waters along the eastern edge of the Montebello Islands and the south-eastern edge of Barrow Island (CALM 2004).

Corals occur on submerged limestone reefs and submarine slopes as fringing reefs and patch reefs in the shallow waters (5–10 m) to the south, east and north of the Lowendal Islands. Corals are also present in slightly deeper waters (up to 20 m) on exposed limestone pavement running north towards the Montebello Islands (LeProvost Semeniuk Chalmers 1986; LDM 1994). This habitat extends south along the eastern edge of the Barrow Island Shoals.

Corals are abundant around Barrow Island, growing as high profile reefs and on pavement on the west and east coasts. The most significant coral reefs around Barrow Island are Biggada Reef on the west coast, Dugong Reef and Batman Reef off the south-east coast, and those along the edge of the Lowendal Shelf on the east side of Barrow Island (Chevron 2008).

Quantitative sampling of seven sites around the Lowendal Islands showed a range of 34 to 63 species or taxa per site, with massive forms such as Favites and Porites, and tubular and digitate species of Acropora dominating the assemblages (LDM 1994). No corals were present in the channel between the Lowendal Islands and the northern tip of Barrow Island. A small submerged fringing reef lies in shallow water on the northeast side of Barrow Island. A total of 235 species comprising 60 coral genera have been recorded from the Montebello Islands during surveys carried out by the WA Museum (WAM 1993).

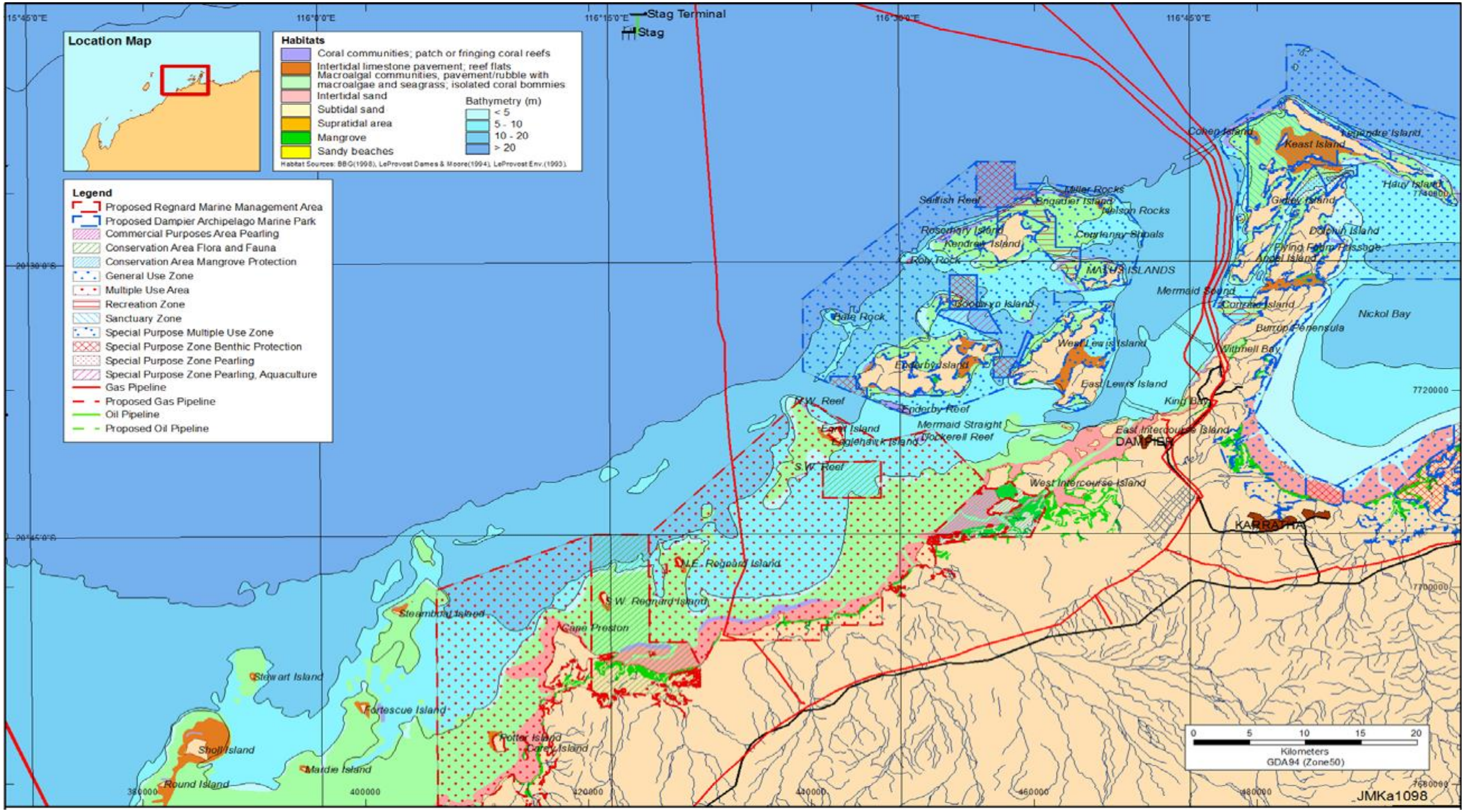

Figure 3-3: Marine Habitats Surrounding the Dampier Archipelago

Offshore Islands between North-West Cape and Dampier Archipelago

Hard corals occur as components of shallow intertidal and subtidal habitats around numerous small offshore islands within this region (including Muiron, Thevenard, Airlie and Serrurier islands) associated with limestone pavement create fringing intertidal reefs, patch reefs or represent isolated coral bomboras. Corals around Muiron Islands are contained within the State managed Muiron Island Marine Management Area.

Ningaloo Reef

Ningaloo Reef is the largest fringing barrier coral reef, and the second largest coral reef system in Australia. The most diverse coral communities along this coastline are in the relatively clear water, high energy environment of the fringing barrier reef and low energy lagoonal areas to the west of North-West Cape. The diversity of hard corals along this coastline is high with at least 217 species representing 54 genera of hermatypic (reef building) corals recorded to date (Veron and Marsh 1988). All 15 families of hermatypic corals are represented, however species diversity and community structure vary with environmental conditions such as exposure to wave action, currents, depth and water clarity. Figure 3-5 provides an overview of habitats, including coral communities. The Ningaloo Reef is protected within the Ningaloo Coast World Heritage Area (Section 3.7.1) and Ningaloo Marine Park (Commonwealth and State waters (Sections 3.7.6.8 and 3.8).

Rowley Shoals

The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located about 300 km northwest of Broome. The shoals contain 214 coral species and ~ 530 species of fish (Done et al. 1994; Gilmour et al. 2007). The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the northwest. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al. 1994). Mermaid Reef is a submerged reef protected by the Commonwealth and managed under the Mermaid Reef Australian Marine Park (see Section 3.7.6.6). Clerke Reef and Imperieuse Reef include permanent sandy cays above the high water mark and are managed by the Western Australian Government as the Rowley Shoals Marine Park (Section 3.8.7).

Coastline between Dampier Archipelago and Eighty Mile Beach

The coastline in this region is subject to high tidal currents and infrequent cyclonic events, and shallow coastal waters are typically very turbid due to suspension of fine sediments driven by these currents. Coral communities along this stretch of coastline typically have lower diversity and density than shorelines further south (e.g. Dampier Archipelago and Ningaloo Reef) and are associated with outcropping limestone subtidal pavement or intertidal rocky shorelines. Corals further offshore typically exhibit greater diversity and density where sediments are coarser and water conditions are less turbid. A total of 51 species of coral from 19 genera have been identified from areas offshore from Port Hedland which is lower than the 120 coral species from 43 genera recorded in Dampier Port and inner Mermaid Sound (Blakeway and Radford 2005). Along this stretch of coastline, corals are less likely to form biogenic reefs and more likely to be present as components of mosaic communities with other benthic organisms.

Rankin Bank and Glomar Shoals

Rankin Bank (19° 46' 44.184" S, 115° 36' 59.220" E) and Glomar Shoals (19° 36' 41.846" S, 116° 44' 4.472" E) are shoals located, over 35nm each way from the Montebellos and approximately 150 km north of Dampier. Glomar Shoal and Rankin Bank are the only large, complex, bathymetrical features on the outer western shelf of the West Pilbara (AIMS 2014). Species of major recreational interest found on these shoals include saddletail snapper, red emperor, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish (Fletcher and Santoro 2012).

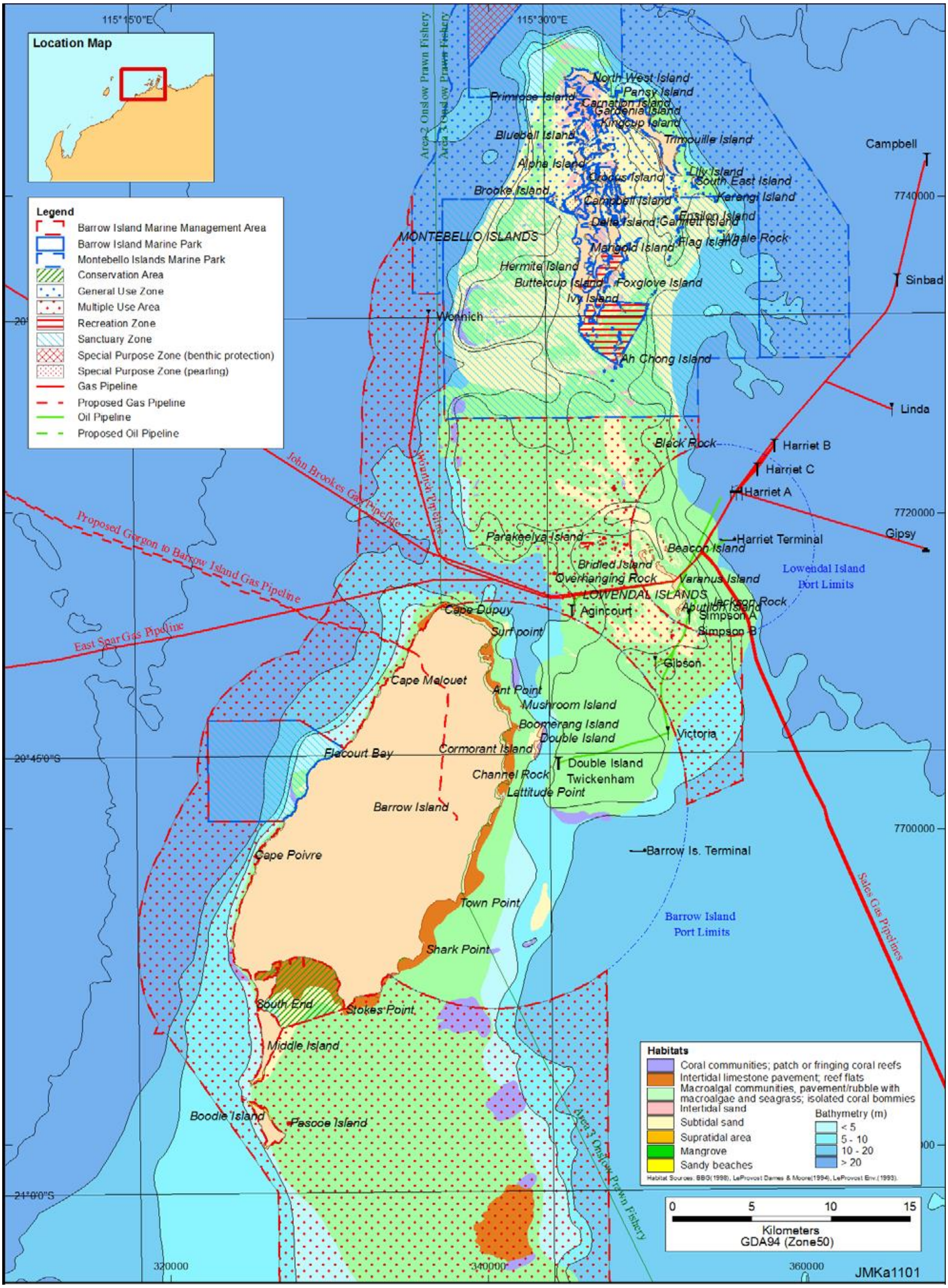

Figure 3-4: Marine Habitats Surrounding the Montebello, Lowendal and Barrow Islands

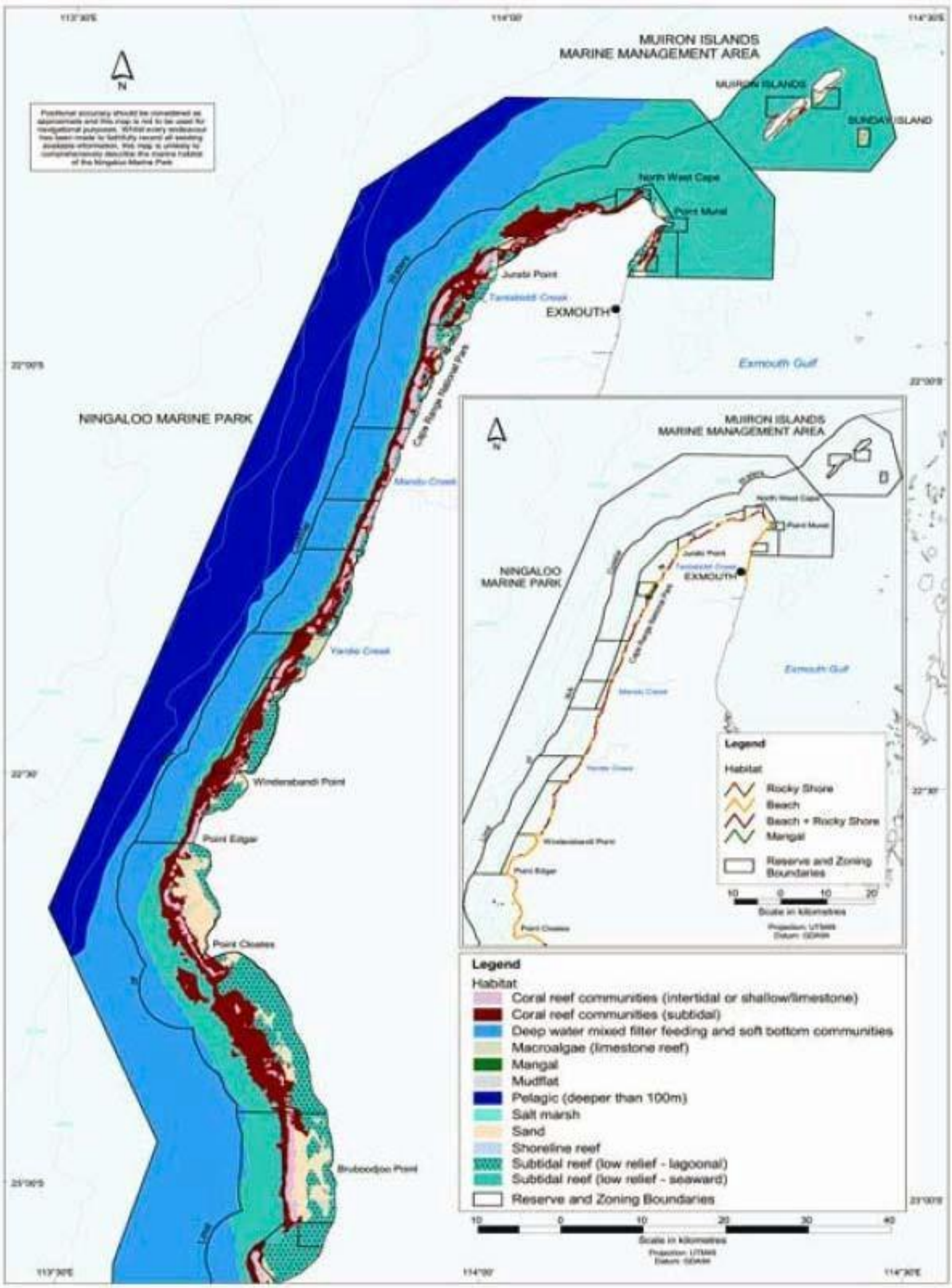

Figure 3-5: Marine Habitats Surrounding the Ningaloo Marine Park North of Point Cloates

The Glomar Shoals have been identified as a Key Ecological Feature (KEF) of the North-west Marine Bioregion (Falkner et al. 2009). The area is known to be an important for many commercial and recreational fish species such as Rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner et al. 2009; Fletcher and Santoro 2012). Catch rates at the Glomar Shoals are high, indicating that it is an area of high productivity.

3.3.4 Macroalgae and Seagrasses

Macroalgae are most prolific over the shallow pavement limestone reefs adjacent to the offshore islands in the region, including those of the Dampier Archipelago 32 km southeast of the Stag Facility location. Seagrasses form extensive meadows over some of the shallow water sandflats (down to approximately 15 m water depth). In deeper waters, macroalgae and seagrasses are less abundant due to lower light levels reaching the benthos.

Macroalgae and seagrasses are important primary producers in tropical inshore waters. Seagrasses are directly grazed by dugongs (Prince 1986) and both seagrasses and macroalgae are grazed by green turtles. Few fish species graze directly on seagrass or macroalgae but both vegetation types support a diverse and abundant invertebrate fauna that are the principal food source for many inshore fish species (Blaber and Blaber 1980). Small crustaceans, such as amphipods, copepods and isopods, emerge from macroalgae and seagrasses at night and are fed upon by planktivorous fish such as herring, sardine and anchovy (Robertson and Watson 1978). Dense schools of these fish are in turn fed upon by both predatory fish, such as tuna and mackerel, and diving birds, such as shearwater and terns. Beds of seagrasses and macroalgae may support the juvenile stages of prawn species that are commercially important in the region (Loneragan et al. 2003).

<u>Dampier Archipelago</u>

Macroalgae dominate submerged limestone reefs and also grow on stable rubble and boulder surfaces in the Dampier Archipelago/Cape Preston region (Figure 3-3). These communities are most commonly found on shallow limestone pavement in depths less than 10 m. Low relief limestone reefs, which are dominated by macroalgae, account for 17% (~ 35,460 ha) of the major marine habitats within the Dampier Australian Marine Park. Brown algae are the most abundant group of algae in the region, with Sargassum sp., Dictyopteris sp. and Padina sp. being the dominant species. The most common green algae are the articulate coralline Halimeda sp, while prominent red algal species include crustose corallines, non-corallines and algal turf. Seagrass occurs in the larger bays and sheltered flats of the region. Six species of seagrass are present on the subtidal soft sediment habitats, these being *Cymodocea angustata, Halophila ovalis, Halophila spinulosa, Halodule uninervis, Thalassia hemprichii* and *Syringodium isoetifolium*. Seagrasses do not form extensive meadows within the proposed reserves, but rather form interspersed seagrass/macroalgae beds. The most significant areas of seagrass are found between Keast and Legendre islands and between West Intercourse Island and Cape Preston (CALM 2005b). Macroalgae and seagrasses are important primary producers, trapping light energy from the sun and making it available to the ecosystem. They also provide important habitats for molluscs, sea urchins, sea stars, sea cucumbers, crabs and fishes. Marine turtles feed on algae and seagrass, and the ephemeral seagrass typically found in the area is likely to be the preferred food source for the resident dugong population.

<u>Montebello/ Barrow/ Lowendal Islands</u>

Macroalgae are the dominant macrophyte in the Montebello/Lowendal/Barrow Island region, occupying approximately 40% of the benthic habitat area of the region (CALM 2004) (Figure 3-4). At least 132 macroalgal taxa occur in marine habitats around Barrow Island with most thought to be widely distributed in the tropical Indo-Pacific region (Dr J. Huisman, pers. comm. in Chevron 2005). Macroalgae generally attach to hard substrates such as rock, although species such Caulerpa, Halimeda, Udotea and Penicillus can anchor in soft sediments or attach to shell fragments or rubble.

The most numerically abundant macroalgae are of the Sargassum genus, which cover the shallow subtidal rock platforms around the islands. Seasonally, Sargassum grows large foliose fronds bearing reproductive structures and then senesce each winter. Consequently, the biomass of the macroalgal beds varies greatly with this seasonal cycle of growth and senescence. Other abundant taxa in the Montebello/Lowendal/Barrow Island region include Halimeda, Caulerpa, Dictyopteris, Dictyota, Cystoseira, Padina, Codium and Laurencia (Chevron 2008).

On the east coast of Barrow Island, macroalgal diversity is highest in the rock pools and toward the deeper edge of the intertidal zone (Chevron 2008). The dominant macroalgae on the east coast platforms are *Cystoseira trinodis*, Sargassum spp., Caulerpa spp. and Halimeda spp. Macroalgal turfs are widespread on the intertidal pavement reef and comprise red algae such as Laurencia, Chondria, Ceramium, Centroceras clavulatum, Gelidiopsis and Hypnea (Chevron 2005; 2008).

Seagrasses in the Montebello/Lowendal/Barrow Island region are sparsely interspersed between macroalgae and do not form extensive meadows. Six species have *been* recorded to date: *Cymodocea angustata*, *Halophila ovalis*, *Halophila spinulosa*, *Halodule uninervis*, *Thalassia hemprichii* and *Syringodium isoetifolium* (CALM 2004). Most of these are small, ephemeral species that grow on subtidal sands and in intertidal pools and have a seed bank in the surficial sediments that allows them to recolonise quickly following disturbance. The most common species are *Halophila ovalis* on the deeper subtidal sand and *Syringodium isoetifolium* and *Halodule uninervis* in the rock pools (Chevron 2005, 2008).

<u>Offshore Islands between North-West Cape and Dampier Archipelago</u>

Macroalgae and seagrass occur around the numerous small offshore islands within this region (including Muiron Islands, Thevenard Island, Airlie Island and Serrurier Island) associated with limestone pavement and protected areas of soft sediments. Dominant species are consistent with those described for the Dampier Archipelago and the Ningaloo Coastline.

<u>Ningaloo Coastline</u>

Macroalgal meadows along the Ningaloo coastline are generally found on the shallow limestone lagoonal platforms and occupy about 2,200 ha of the Ningaloo Marine Park and Muiron Islands MMA (CALM 2005a) (Figure 3-5). Macroalgal communities within the Park have been broadly described (Bancroft and Davidson 2001). The dominant genera are Sargassum, Padina, Dictyota and Hydroclathrus (McCook et al. 1995). Seagrass species are generally patchily distributed and are not a major component or a major primary producer on the reef (CALM 2005a). The biogeography of several species such as *Cymodocea angustrata*, *Cymodocea serrulate*, *Halodule uninervis*, *Haliphola ovalis*, *Haliphola spinulosa*, *Syringodium isoetifolium*, and *Thalassodendron ciliatum* suggest that these species are likely to occur in the reserves. It is also highly likely that some temperate species have their northernmost limit in the reserves.

<u>Exmouth gulf</u>

Exmouth Gulf is a rich marine environment. It is a resting ground for humpback whales, and important area for dugong and turtles. The mangrove systems on the eastern margins are areas of high primary productivity feeding and are a nursery for fish both within the Gulf and the nearby Ningaloo Reef (Section 3.8.6).

The mangroves along the eastern side of the gulf stretch for nearly 50 km. They have been identified by BirdLife International as a 420 km^2 Important Bird Area (IBA) because they support over 1% of the world populations of pied oystercatchers and grey-tailed tattlers, as well as being an important site for the restricted-range dusky gerygone. Another IBA is 11 ha Sunday Island, lying in the north of the Gulf near the Muiron Islands, which is an important nesting site for roseate terns.

<u>Coastline between Dampier Archipelago and Eighty Mile Beach</u>

Tropical macroalgae and seagrass species occur in the shallow waters along this stretch of coastline and are typically associated with areas of outcropping hard substrate and protected soft sediments, respectively. Abundance and biomass typically exhibit strong seasonal trends. Common algae species in the Port Hedland region include tropical genera such as Sargassum, Caulerpa and Halimeda with seagrass including ephemeral Halophila spp (BHPB 2011).

3.4 Intertidal Shoreline Habitats

3.4.1 Mangroves

Mangroves are recognised as significant as they are productive coastal forest systems, providing habitat and shelter for infauna, epifauna, gastropods, crustaceans, fish and other marine species. Mangroves are important nursery areas for fish, lobster and prawn species, some of which are targeted by recreational and commercial fishers. Mangroves may also provide shelter for other species such as juvenile turtles. Ospreys (*Pandion haliaetus*) and white-bellied sea eagles (*Haliaeetus leucogaster*) roost in mangroves, while a range of smaller birds' nest in them (DEC 2007a). Mangroves are also recognised for their capacity to protect coastal areas from erosion due to storms and storm surge. In WA, mangroves are generally of high conservation significance and are protected throughout under the Wildlife Conservation Act 1950.

The regional mangroves of mainland and islands from Exmouth to Eighty Mile Beach represent Australia's only 'tropical-arid' mangroves. Within the NWS region, mangroves are present on the Montebello and Lowendal Islands, along the south eastern and southern shores of Barrow Island, in sheltered pockets on the offshore islands of the Dampier Archipelago, along the western side of the Cape Range Peninsula, on the eastern shore of Exmouth Gulf, and in extensive stretches along many creeks and watercourses on the mainland coast. WA does not support any unusual endemic or restricted mangrove species. All mangrove species within WA are common and widespread elsewhere, either in northern Australia, or in the Indo-pacific region proximal to northern Australia.

<u>Dampier Archipelago</u>

Six species of mangrove are found within the Dampier Archipelago/Cape Preston region, these being the white mangrove (*Avicennia marina*), red mangrove (*Rhizophora stylosa*), club mangrove (*Aegialitis annulata*), ribbed fruit orange mangrove (*Brugiera exaristrata*), yellow leaf spurred mangrove (*Ceriops tagal*) and river mangrove (*Aegiceras cornculatum*). Mangrove communities (mangals) account for 3% (~5,950 ha) of the Dampier Archipelago Marine Park and Cape Preston MMA (Figure 3-3). Most of these communities are along the mainland coast on the tidal flats at Regnard Bay, the Maitland River mouth, King Bay and Nickol Bay. Well-developed communities also occur in some of the sheltered bays on the islands, for example at West Intercourse Island, in Searipple Passage and the southern shores of West Lewis and East Lewis islands (CALM 2005b). The mangrove communities at the Fortescue River delta, Cape Preston area, West Intercourse Island, Enderby Island, Searipple Passage/Conzinc Bay and Dixon Island have been assessed by Semeniuk (1997) as having international significance from a biodiversity and ecological basis.

<u>Montebello/ Barrow/ Lowendal Islands</u>

The mangroves of the Montebello Islands (Figure 3-4) are globally significant because they are the world's only mangroves growing in lagoons of offshore islands (Semeniuk 1997). Six species of mangrove are found on the islands: *Avicennia marina*, *Bruguiera exaristata*, *Ceriops tagal*, *Rhizophora stylosa*, *Aegialitis annulata* and *Aegiceras corniculatum*. Mangroves on the Montebello islands occur as isolated trees through to patches of continuous forest, the largest being a 15 ha stand in Stephenson Channel (DEC 2007a).

Within the Lowendal Island group, three species of mangroves are found on Varanus, Abutilon and Bridled Islands. Mangrove distribution within the Lowendals is very restricted, being largely determined by local geomorphology, substrate type, and soil water and groundwater salinity (VCSRG 1988).

On Barrow Island, mangroves are restricted to a few small areas on the east and southern coast at Mattress Point, south of Chevron camp, near the airstrip, at Stokes Point and near Pelican Island on the western side of Bandicoot Bay (Chevron 2008). *Avicennia marina* is the most common species, although *Rhizophora stylosa* is also present. These mangroves are generally poorly developed in comparison to their mainland counterparts and generally occur as a narrow band of stunted trees. Nevertheless, mangroves on Barrow Island are important habitat for many avifauna species, including ospreys and white-bellied sea eagles, and for red fiddler crabs (Uca sp.) at Square Bay (RPS BBG 2005).

<u>Ningaloo Coastline</u>

Three species of mangroves have been identified within Ningaloo Marine Park. The dominant species is the white mangrove (*Avicennia marina*), with the red mangrove (*Rhizophora stylosa*) and the ribbed-orange fruit mangrove (*Bruguiera exaristata*) existing in limited numbers (May et al. 1983). The largest mangrove community (~31 ha), found within Mangrove Bay, is characterised by established trees to 5 m in height. Established mangrove stands can also be found associated with tidal creek systems including a well-developed mangal within Yardie Creek.

Coastline between Dampier Archipelago and Eighty Mile Beach

Mangroves are a common habitat within sheltered areas such as estuaries, tidal creeks and sheltered bays, along the mainland between Dampier Archipelago and Eighty Mile Beach. Seven species of mangrove have been recorded within the Port Hedland Industrial Area, with *Avicennia marina* and *Rhizophora stylosa* being the most abundant (BHPB 2011). *Avicennia marina* is the dominant mangrove within mangrove stands at Eighty Mile Beach.

3.4.2 Coastal Salt Marsh

Coastal salt marsh is a transitional habitat between land and salty or brackish water (e.g. in bays and estuaries). It is dominated by halophytic (salt tolerant) herbaceous plants (e.g. samphires). In the Port Hedland Industrial Management Unit and surrounding areas, salt marsh habitat commonly replaces mangrove stands with increasing distance from the water line where sediments are drier and more saline (BHPB 2011). Salt marshes are also a feature of the landscape further north, at Eighty Mile Beach. Salt marshes may be inundated by spring high tides and therefore may be exposed to oil spills on spring high tides.

3.4.3 Sandy Beaches

Sandy beaches are those areas within the intertidal zone in which unconsolidated sediment has been deposited by wave and tidal action. Sandy beaches can vary from low to high energy zones which will influence their profile through varying rates of erosion and accretion. Sandy shorelines are generally interspersed among areas of hard substrate (e.g. sandstone) that form intertidal platforms and rocky outcrops. Sandy beaches provide habitat to a variety of burrowing invertebrates and subsequently provide foraging grounds for shorebirds (DNP 2013), as well as important habitat for nesting turtles.

Sandy beaches are found throughout the bioregion on both the mainland at Eighty Mile beach, Dampier and Onslow, as well as on many of the numerous islands throughout including Barrow Island, Murion Islands, Thevenard, Serrurier, Dampier Archipelago, Bedout Island, North Turtle Island, and the chain of nearshore islands covered under the Great Sandy Island Nature Reserves. Eighty Mile Beach Marine Park is one of the Australia's largest uninterrupted sandy beaches (stretching 220 km) and is an important feeding ground for small wading birds that migrate to the area each summer, travelling from countries thousands of kilometres away (DEC 2011). It is also a listed Ramsar wetland (see Section 3.7.4).

3.4.4 Mud Flats

Intertidal mudflats form when fine sediment carried by rivers and the ocean is deposited in a low energy environment. Tidal mudflats are highly productive components of shelf ecosystems responsible for recycling organic matter and nutrients through microbial activity. This microbial activity helps stabilise organic fluxes by reducing seasonal variation in primary productivity which ensures a more constant food supply (Robertson 1988). Intertidal sand and mudflats support a wide range of benthic infauna and epifauna which graze on microscopic algae and microbenthos, such as bivalves, molluscs, polychaete worms and crustaceans (Zell 2007).

The high abundance of invertebrates found in intertidal sand and mudflats provides an important food source for finfish and shellfish which swim over the area at high tide. Mudflats have also been shown to be significant nursery areas for flatfish. During low tide, these intertidal areas are also important foraging areas for indigenous and migratory shorebirds. Mudflats also play a vital role in protecting shorelines from erosion (Wade and Hickey 2008).

Eighty Mile beach has significant intertidal mudflats that are used by birds in spring and summer including species listed as threatened under the EPBC Act or listed on the IUCN Red List of Threatened Species (2017). The sediments that dominate these flats are generally of terrigenous origin (Wilson 2013).

3.4.5 Rocky Shorelines

Intertidal platforms are areas of hard bedrock and/or limestone with or without a sediment veneer of varying thickness. These platforms can vary from low to high relief and provide a habitat for a diverse range of intertidal organisms (Morton and Britton in Jones 2004, SKM 2009, 2011, and Hanley and Morrison 2012) and some species of shore birds (Garnet and Crowley 2000). They are common within each of the coastal bioregions within the area of interest.

Intertidal rock pavement and rocky shores are typically associated with high stress environments, with periods of desiccation, predation and sometimes strong wave energies. The higher tidal ranges and less severe wave action in the north mean that smooth intertidal slopes are not common. Intertidal rock pavement is a significant part of the marine landscape, due to the high biological productivity, and their sediments on the coast through erosion and biological production of material such as shell fragments. Some platforms protect nearshore waters, such as Ningaloo and North-West Cape, which is separated from the coast by shallow water lagoons.

Rocky coasts occur where there is a lack of sandy sediment or where erosion has exposed the underlying rock. Rocky shores can include pebble/cobble, boulders, and rocky limestone cliffs (often at the landward edge of reef platforms). Rocky shorelines are an important foraging area for seabirds and habitat for invertebrates found in the intertidal splash zone (Morton and Britton in Jones 2004). For example, oyster catchers and ruddy turnstones feed along beaches and rocky shorelines.

Rocky shores dominate on most of the Barrow and Montebello islands and provide habitat for a variety of intertidal organisms. CALM (2004) estimated the linear extent of rocky shore habitat in the zone as approximately 63% of the coastline, and a further 11% was categorised as beach interspersed with rocky shore. Rocky shores provide food for shorebirds (Chevron 2010) and are also common within the Dampier Archipelago, notably King and Conzinc Bays, and Angel, Gidley, Enderby and the Lewis Islands.

3.4.6 Summary of Habitats within the Operational Area and EMBA

Table 3-1 summarises the habitats that may be affected by routine events at the Stag Facility within the Operational Area as well as unplanned events that may arise within a larger EMBA.

Table 3-1: Environmental Values and Sensitivities for Habitats within the Operational Area

Habitats	Environmental value	Sensitivities within the Operational Area	Sensitivities within the EMBA
Subtidal Benthic Habitats			
Soft sediments and benthic fauna	Support a diverse infauna consisting predominantly of mobile burrowing species that include molluscs, crustaceans (crabs, Shrimps and smaller related species), polychaetes, sipunculid and platyhelminth worms, asteroids (sea stars), echinoids (sea urchins) and other small animals. Biological activity occurs throughout the year.	**Yes –** Soft sediment is the dominant habitat.	**Yes –** Soft sediment is the dominant subtidal habitat throughout the EMBA.
Hard Coral habitat	Food source for some fish species; Integral source of carbonate sediments; large component of primary productivity and habitat to	**No**	**Yes –** Important coral localities: Dampier Archipelago, Ningaloo Reef, Muiron Islands Barrow/ Montebello/Lowendal Island

	regional marine ecology Peak coral spawning occurs March–April Coral spawning also occurs October–November.		group and Rowley Shoals.
Macroalgae beds	Primary producers; dugong and turtle feeding habitat; support a diverse and abundant fauna of small invertebrates that are the principal food source for many inshore tropical fish species Produce reproductive structures and then senesce each winter (May–September).	**No**	**Yes –** Macroalgal habitat prevalent within shallow waters (photic zone) associated with primarily rocky substrate along the mainland coast and associated with offshore islands.
Seagrasses meadows	Primary producer; dugong feeding habitat Throughout the year they are growing or shedding fronds.	**No**	**Yes –** Seagrasses occur within the photic zone along the Dampier Archipelago, Ningaloo Reef, Muiron Islands Barrow/ Montebello/ Lowendal Island group.
Hard substrates and epiflora/ fauna	Support higher diversity of Epifauna than soft sediment habitats and provide surfaces for attachment of fauna (e.g. hard coral, soft corals, sponges) and macroalgae.	**No**	**Yes –** Hard substrates occur throughout the EMBA. Filter feeding epifauna can occur across a range of depths. Benthic primary production associated with hard substrate restricted to shallow photic zone.
Intertidal Shoreline Habitats			
Mangroves	An important primary producer habitat along shorelines of the Pilbara mainland and islands. Important habitat for birds, molluscs, crustaceans, juvenile fish; bird watching hide. Important for shoreline stabilisation and nutrient recycling.	**No**	**Yes –** Along mainland coastline between Ningaloo coast to Broome; Montebello and Lowendal Islands south eastern and southern shores of Barrow Island and in sheltered pockets on the offshore islands of the Dampier Archipelago and Exmouth Gulf.
Salt marsh	Primary producer habitat commonly occurring landward of mangrove stands. Salt marshes stabilise sediments, recycle nutrients and provide habitat for coastal fauna.	**No.**	**Yes –** Can be distributed landward of mangrove habitat in brackish environment. Known occurrence between Port Hedland and Eighty Mile Beach.
Sandy beaches	Shorebird foraging/ breeding habitat; turtle nesting habitat. Crested tern nesting post-wet season; turtle nesting October to February; hatchling emergence November to April.	**No**	**Yes –** Sandy beaches occur throughout the region. Important sites occur on Eighty Mile beach, Dampier and Onslow, as well as on many of the numerous islands including Barrow Island, Murion Islands, Thevenard, Serrurier, Dampier Archipelago, Bedout Island, North Turtle Island.
Mud/sand flats	Support a diverse assemblage of vertebrates and invertebrates, macroalgae and seagrass. Biological activity occurs throughout the year.	**No**	**Yes –** Found throughout the EMBA. Important site is Eighty-Mile Beach which is a Ramsar site important for migratory shorebirds.

Rocky shorelines	Foraging area for shorebirds. Invertebrates found in the vertical splash zone; roosting areas for seabirds. Biological activity occurs throughout the year.	**No**	**Yes –** Found throughout the EMBA including Ningaloo Coast, Muiron Islands, Montebello/ Barrow/ Lowendal Islands and Dampier Archipelago.

3.5 Marine Fauna

Fauna that may be present within the EMBA for the activity include plankton, invertebrates, fish, marine mammals, marine reptiles and seabirds.

3.5.1 Plankton

Plankton is divided into two categories: phytoplankton and zooplankton. Phytoplanktonic algae are important primary producers and range in size from 0.2 to 200 mm. Zooplankton are small, mostly microscopic animals that drift with the ocean currents, and it has been estimated that 80% of the zooplankton in waters off Australian continental shelf and shelf margin are the larval stages of fauna that normally live on the seabed (Raymont, 1983). A common feature of plankton populations is the high degree of temporal and spatial variability. Phytoplankton in tropical regions have marked seasonal cycles with higher concentrations occurring during the winter months (June–August) and low in summer months (December–March) (Hayes et al., 2005; Schroeder et al., 2009). Zooplankton rely on phytoplankton as food and are subject to similar seasonality.

3.5.2 Invertebrates

Pelagic invertebrates other than zooplankton include mobile cnidarians (jellyfish), salps and squid. Larger marine fauna such as leatherback turtles may consume jellyfish, whereas fish and large mammals such as dolphins and whales generally consume squid.

The mostly sandy substrates within the North-west Marine Bioregion are thought to support low densities of benthic communities, such as bryozoans, molluscs and echinoids (DEWHA, 2008a). In areas of harder substrates, sponge communities are sparsely distributed.

Apache sampled the biota surrounding the location of the Stag Facility and loadout location prior to development drilling of this Facility, to provide a baseline for comparison to the post-development and post-commissioning situation (Kinhill, 1997, 1998). Sampling confirmed that the benthic biota within the vicinity of Stag Field was comparable to that found over similar substratum and at similar depths over the wider region (Ward and Rainer, 1988; Woodside, 1988; Rainer, 1991). The unconsolidated sediments in this habitat support a diverse infauna, consisting predominantly of mobile burrowing species such as crustaceans (crabs, shrimps and smaller related species), polychaete, sipunculid and platyhelminth worms, asteroids (sea stars), echinoids (sea urchins), and other small infaunal animals.

The abundance and composition of this infauna is variable over both space and time (Ward and Rainer, 1988; Rainer, 1991; Kinhill, 1997). Differences between locations are related to such factors as depth and seafloor texture while changes over time within a location may be related to changes in the physical environment, such as water temperature or wave-induced currents. Ward and Rainer (1988) reported a seasonal pattern in the abundance of small species of decapod crustaceans in this region. However, because they only sampled at two times, it is not clear if this pattern was related to season or to other factors, such as storm events, which operate at much shorter time scales. By comparison to the infauna, the diversity and abundance of large encrusting animal species (epibenthic fauna) in this region is relatively low (Ward and Rainer, 1988; Woodside, 1988; Kinhill, 1997). This is probably due to instability of the sediment and the lack of exposed and colonisable reef.

3.5.3 Fish

The NWMR supports large populations of cartilaginous fishes (such as sharks and rays), that are typically higher-order predators and perform an important ecological role through the regulation of prey species. The

NWMR contains 157 chondrichthyan species (sharks, skates and rays), 18 of which are endemic. This includes 94 shark species, many of which are found in other parts of Australia, and which represent approximately 19% of the world's shark species (Heupel and McAuley, 2007). Sharks, skates and rays occupy a broad range of habitats, from shallow to deep-water, with some species being pelagic.

Large pelagic fish such as tuna, mackerel, swordfish, sailfish and marlin are another important component of the ecosystem and are found mainly in oceanic waters and occasionally on the continental shelf (Brewer et al., 2007). Both juvenile and adult phases of the large pelagic species are highly mobile and have wide geographic distributions, although the juveniles more frequently inhabit warmer or coastal waters (DEWHA 2008a).

The demersal habitat of the NWS hosts a diverse assemblage of fish of tropical Indo-west Pacific affinity, with up to 1,400 species known to occur – many in shallow coastal waters (Allen et al., 1988). Last et al. (2005) described the North-west Shelf Province as being characterised by a high level of endemism and species diversity. Many of these fish species are commercially exploited by trawl and trap fisheries, for example the genera Lethrinus (emperor) and Lutjanus (snapper) (Sainsbury et al., 1985).

Within the southern portion of the North-west Shelf Province, small pelagic fish (e.g. lantern fishes) comprise a third of the total fish biomass (Bulman, 2006), and play an important ecological role, not only for this particular area but for the entire NWMR. They inhabit a range of marine environments, including inshore and continental shelf waters and form a vital link within and between many of the region's trophic systems, feeding on pelagic phytoplankton and zooplankton and providing a food source for a wide variety of predators including large pelagic fish, sharks, seabirds and marine mammals (Mackie et al., 2007).

The shallow waters (<30 m) of the Dampier Archipelago support a characteristic and rich fish fauna of 650 species from a variety of habitats including coral and rocky reefs, mangroves, sand and silty bottoms and sponge gardens (Hutchins, 2004). The majority of these species were found over hard substrate, but significant numbers were also found from soft bottom and mangrove areas. The outer islands of the Archipelago are inhabited predominantly by coral reef fishes whereas inner areas close to the mainland are occupied by mangrove and silty-bottom dwellers. The inter-island passages have a relatively rich soft bottom fauna. The fish fauna of the archipelago is less diverse that the islands of the West Pilbara to the south but are closely related to the fauna at the offshore Montebello Islands (Hutchins, 2004). EPBC Act protected fish species within the Dampier Archipelago include the dwarf sawfish (*Pristis clavata*).

The Glomar Shoals, approximately 70 km north-east of the Stag Facility (Section 3.7.6.9), have been identified as a Key Ecological Feature (KEF) of the North-west Marine Bioregion (Falkner et al., 2009). The area is known to be an important for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Brewer et al., 2007; Falkner et al., 2009; Fletcher and Santoro, 2012). Catch rates at the Glomar Shoals are high, indicating that it is an area of high productivity.

Continental Slope Demersal Fish Communities have also been identified as a KEF within the Stag Facility EMBA (Section 3.7.6.9) which are located 110 km NW of the Stag Facility. This KEF represents the continental slope between North-West Cape and the Montebello Trough, which supports more than 500 fish species, 76 of which are endemic, making it the most diverse slope bioregion in Australia. The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fish, of which 64 are considered to be endemic, and is the second richest area for demersal fish species across the entire Australian continental slope.

Similar to that of the Stag Facility and surrounds, the fish fauna of Barrow/Lowendal/Montebello Islands are widespread throughout the Indo-west Pacific region, but also include species protected by legislation. Protected species within the Barrow/Lowendal/Montebello Islands include the whale shark (Rhincodon typus), great white shark (Carcharodon carcharias) and grey nurse shark (Carcharias taurus).

The warm waters of the NWS are thought to be the location of spawning for some fish species. Some fish species are likely to be more susceptible than others to impact due to their physical characteristics (e.g. size, ability to move quickly) and behaviours (e.g. schooling, spawning aggregations). The life stage (i.e. egg, larvae, juvenile, adult) of a fish is also likely to influence its susceptibility to impacts. A summary of key species likely to spawn in the EMBA (DoF 2013) can be found in Table 3-2.

Table 3-2: Spawning Dates for Key Fish Species

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blacktip shark (*Carcharhinus tilstoni and C. limbatus*)											■	■
Goldband snapper (*Pristipomoides multidens*)	■	■	■	■								
Rankin cod (*Epinephelus multiinotatus*)								■	■	■		
Red Emperor (*Lutjanus sebae*)	■		■							■		
Sandbar shark (*Carcharhinus plumbeus*)	■									■	■	■
Spanish mackerel (*Scomberomorus commerson*)								■	■	■	■	
Pink snapper (*Pagrus auratus*)					■	■	■	■				
Baldchin groper (*Choerodon rubescens*)	■	■							■	■	■	■
Crystal (snow) crab (*Chaceon* spp.) Gascoyne	■	■	■	■	■	■	■	■	■	■	■	■
Champagne (spiny) crab (Hypothalassia acerba)			■	■	■							

3.5.4 Crustaceans

The NWMR is thought to contain a high diversity of crustaceans across a range of habitats, from intertidal sites to the deeper waters of the slope and the abyss. Dominant species groups include copepods, prawns, scampi and crabs. These groups display a strong biogeographic affinity with the Indo-west Pacific, with few endemic species present. As well as being preyed upon by large pelagic fish, crustaceans are also a significant food for cephalopods (squid and octopus species; DEWHA 2008a). The North-West Slope Trawl Fishery (NWSTF) targets scampi in the NWMR. Data from the fishery suggests that muddy sediments support significant populations of crustaceans (DoF 2012).

3.5.5 Cephalopods

Approximately 81 different species of cephalopod are believed to occur in the NWMR, five of which may be endemic as they have only been recorded from one location or are thought to have a very restricted distribution (DEWHA 2008a). The area between Kalbarri and the Dampier Archipelago appears to be particularly significant for octopus, dumpling squids and several species of cuttlefish (DEWHA 2008a). Squid are an important food item for a number of species in the NWMR. Sperm whales, for example, feed exclusively on the Japanese flying squid (*Todarodes pacificus*) and sharpear enope squid (*Ancistrocheirus lesueurii*), while seabirds (such as black noddies and red-footed boobies) feed on the purple back flying squid

(*Sthenoteuthis oualaniensis*; DEWHA 2008a).

Information on species listed under the EPBC Act such as sharks, turtles, cetaceans and avifauna are covered in Section 3.6.

Table 3-3 summarises the fauna that may be affected by routine events at the Stag Facility within the Operational Area as well as unplanned events that may arise within a larger EMBA.

3.6 Threatened and Migratory Species

The EPBC Act lists both threatened and migratory species that are protected under Commonwealth legislation and various international conventions and treaties.

A search of the EPBC Act Protected Matters Database in December 2021 (Appendix B) identified 57 threatened species (endangered, vulnerable, and critically endangered) as occurring or having habitat within the EMBA (Table 3-3). Twenty of these threatened species are terrestrial and have been excluded as it is unlikely that they would be impacted from an oil spill associated with the activity.

The relevant sections of this EP discuss the likelihood of these species and their biologically important areas occurring within the Operational Area and EMBA. Those species that have been identified as likely to be present in the Operational Area and EMBA are summarised in Table 3-3 and further detailed below.

BIAs such as an aggregation, resting, nesting or feeding areas or known migratory routes for these species are shown in Figure 3-6 to Figure 3-13. The relevant sections also outline the management such as:

- Recovery plans;
- Conservation advice; or
- Threat abatement plan for the impacts of marine debris on vertebrate marine life (DoEE 2018).

The requirements of the species recovery plans and conservation advices are considered to identify any requirements that may be applicable to the risk assessment. Recovery plans, conservation advice, management plans and threat abatement plans relevant to species that occur or may occur within the Operational Area and EMBA are detailed in Table 3-4.

No listed threatened ecological communities were identified within the EMBA. Further detail on species identified as threatened or migratory is presented in the following sections. Appendix B contains the full PMST search and includes additional listed species that are not classified as threatened or migratory under the EPBC Act but are considered ‘Other matters protected by the EPBC Act’. This list comprises additional cetaceans, birds, fish (pipefish, pipehorses and seahorses) and reptiles (sea snakes).

Table 3-3: Marine Fauna and Management Considerations in the Operational Area and EMBA

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
Fish and Sharks	Grey nurse shark (west coast population)	*Carcharias taurus*	V	No	Yes	Marine debris[1]	Not relevant to EMBA	Yes	Yes	**Planned Events:** Light Emissions Noise Emissions Operational Discharges Drilling Discharges Physical disturbance Spill Response Activities **Unplanned Events (all)**
	White shark	*Carcharodon carcharias*	V; M	No	Yes	No	Not relevant to EMBA	Yes	Yes	
	Dwarf sawfish	*Pristis clavata*	V; M	Yes	Yes	No	EMBA	Yes	Yes	
	Green sawfish	*Pristis zijsron*	V; M	Yes	Yes	No	EMBA	Yes	Yes	
	Whale shark	*Rhincodon typus*	V; M	Yes	No	No	EMBA	Yes	Yes	
	Reef Manta Ray	*Manta alfredi*	M	No	No	No	None	Yes	Yes	
	Giant Manta Ray	*Manta birostris*	M	No	No	No	None	Yes	Yes	
	Narrow sawfish	*Anoxypristis cuspidata*	M	No	No	No	None	Yes	Yes	
	Oceanic Whitetip Shark	*Carcharhinus longimanus*	M	No	No	No	None	Yes	Yes	
	Freshwater/ Largetooth sawfish	*Pristis pristis*	V; M	Yes	Yes	No	EMBA	No	Yes	**Unplanned Events:** Unplanned release of Stag crude Oil Unplanned release of marine diesel
	Blind Gudgeon	*Milyeringa veritas*	V	Yes	No	No	None	No	Yes	
	Blind Cave Eel	*Ophisternon candidum*	V	Yes	No	No	None	No	Yes	
	Shortfin mako	*Isurus oxyrinchus*	M	No	No	No	None	No	Yes	

[1] Threat abatement plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE 2018)

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Longfin mako	*Isurus paucus*	M	No	No	No	None	No	Yes	
	Porbeagle mackerel shark	*Lamna nasus*	M	No	No	No	None	No	Yes	
Marine mammals	Blue whale	*Balaenoptera musculus*	E; M	No	Yes	Marine debris	EMBA	Yes	Yes	**Planned Events:** Light Emissions Noise Emissions Operational Discharges Drilling Discharges Physical disturbance Spill Response Activities **Unplanned Events (all)**
	Humpback whale	*Megaptera novaeangliae*	M	No	No	Marine debris	EMBA	Yes	Yes	
	Bryde's whale	*Balaenoptera edeni*	M	No	No	Marine debris	None	Yes	Yes	
	Killer whale	*Orcinus orca*	M	No	No	Marine debris	None	Yes	Yes	
	Indo-Pacific humpback dolphin	*Sousa chinensis*	M	No	No	No	Not relevant to EMBA	Yes	Yes	
	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus*	M	No	No	Marine debris	Not relevant to EMBA	Yes	Yes	
	Sei whale	*Balaenoptera borealis*	V; M	Yes	No	Marine debris	None	No	Yes	**Unplanned Events:** Unplanned release of Stag crude Oil Unplanned release of marine diesel
	Fin whale	*Balaenoptera physalus*	V; M	Yes	No	Marine debris	None	No	Yes	
	Southern right whale	*Eubalaena australis*	E; M	No	Yes	Marine debris	Not relevant to EMBA	No	Yes	
	Antarctic minke whale	*Balaenoptera bonaerensis*	M	No	No	Marine debris	None	No	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Dugong	*Dugong dugon*	M	No	No	Marine debris	EMBA	No	Yes	
	Australian Snubfin Dolphin	*Orcaella heinsohni*	M	No	No	No	Not relevant to EMBA	No	Yes	
	Sperm whale	*Physeter macrocephalus*	M	No	No	No	Not relevant to EMBA	No	Yes	
Marine reptiles	Loggerhead turtle	*Caretta caretta*	E; M	No	Yes	Marine debris	EMBA	Yes	Yes	**Planned Events:** Light Emissions Noise Emissions Operational Discharges Drilling Discharges Physical disturbance Spill Response Activities **Unplanned Events (all)**
	Green turtle	*Chelonia mydas*	V; M	No	Yes	Marine debris	EMBA	Yes	Yes	
	Leatherback turtle	*Dermochelys coriacea*	E; M	Yes	Yes	Marine debris	EMBA	Yes	Yes	
	Hawksbill turtle	*Eretmochelys imbricata*	V; M	No	Yes	Marine debris	EMBA	Yes	Yes	
	Flatback turtle	*Natator depressus*	V; M	No	Yes	Marine debris	EMBA	Yes	Yes	
	Short-nosed seasnake	*Aipysurus apraefrontalis*	CE	Yes	No	No	None	No	Yes	**Unplanned Events:** Unplanned release of Stag crude Oil Unplanned release of marine diesel
	Leaf- scaled seasnake	*Aipysurus foliosquama*	CE	Yes	No	No	None	No	Yes	
	Salt-water crocodile	*Crocodylus porosus*	M	No	No	No	None	No	Yes	
Birds	Curlew Sandpiper	*Calidris ferruginea*	CE; Mw	Yes	No	No	None	Yes	Yes	**Planned Events:** Light Emissions Atmospheric
	Eastern Curlew	*Numenius madagascariensis*	CE; Mw	Yes	No	No	None	Yes	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Red Knot	*Calidris canutus*	E; Mw	Yes	No	No	None	Yes	Yes	emissions Operational Discharges Drilling Discharges Physical disturbance Spill Response Activities **Unplanned Events (all)**
	Southern giant-petrel	*Macronectes giganteus*	E; Mw	No	Yes	Marine Debris Bycatch	Not relevant to EMBA	Yes	Yes	
	Australian fairy tern	*Sternula nereis nereis*	V	Yes	No	No	EMBA	Yes	Yes	
	Streaked shearwater	*Calonectris leucomelas*	M	No	No	No	None	Yes	Yes	
	Lesser frigatebird	*Fregata ariel*	M	No	No	No	EMBA	Yes	Yes	
	Common noddy	*Anous stolidus*	M	No	No	No	Not relevant to EMBA	Yes	Yes	
	Common sandpiper	*Actitis hypoleucos*	Mw	No	No	No	None	Yes	Yes	
	Osprey	*Pandion haliaetus*	Mw	No	No	No	None	Yes	Yes	
	Sharp-tailed sandpiper	*Calidris acuminata*	Mw	No	No	No	None	Yes	Yes	
	Pectoral Sandpiper	*Calidris melanotos*	Mw	No	No	No	None	Yes	Yes	
	Australian Lesser Noddy	*Anous tenuirostris melanops*	V	Yes	No	No	Not relevant to EMBA	No	Yes	**Unplanned Events:** Unplanned release of Stag crude Oil Unplanned release of marine diesel
	Great Knot	*Calidris tenuirostris*	CE; Mw	Yes	No	No	None	No	Yes	
	Northern Siberian Bar-tailed Godwit (menzbieri)	*Limosa lapponica menzbieri*	CE; Mw	Yes	No	No	None	No	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Lesser Sand Plover	*Charadrius mongolus*	E; Mw	Yes	No	No	None	No	Yes	
	Greater Sand Plover	*Charadrius leschenaultii*	V; Mw	Yes	No	No	None	No	Yes	
	Australian painted snipe	*Rostratula australis*	E; Mw	Yes	No	No	None	No	Yes	
	Soft-plumaged petrel	*Pterodroma mollis*	V	Yes	No	No	Not relevant to EMBA	No	Yes	
	Abbott's Booby	*Papasula abbotti*	E	Yes	No	No	None	No	Yes	
	Christmas Island White- tailed tropicbird	*Phaethon lepturus fulvus*	E	Yes	No	No	None	No	Yes	
	Shy Albatross	*Thalassarche cauta*	E; M	Yes	Yes	Bycatch Marine Debris	Not relevant to EMBA	No	Yes	
	Campbell Albatross	*Thalassarche impavida*	V; M	No	Yes	Bycatch	Not relevant to EMBA	No	Yes	
	Black-browed Albatross	*Thalassarche melanophris*	V; M	No	Yes	Bycatch Marine Debris	Not relevant to EMBA	No	Yes	
	White-capped Albatross	*Thalassarche steadi*	V; M	No	Yes	Bycatch Marine Debris	Not relevant to EMBA	No	Yes	
	Flesh-footed	*Ardenna carneipes*	M	No	No	Marine debris	Not relevant	No	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Shearwater					Bycatch	to EMBA			
	Wedge-tailed shearwater	*Ardenna pacificus*	M	No	No	Marine debris Bycatch	EMBA	No	Yes	
	Fork-tailed swift	*Apus pacificus*	M	No	No	No	None	No	Yes	
	Great frigatebird	*Fregata minor*	M	No	No	No	Not relevant to EMBA	No	Yes	
	Caspian tern	*Hydroprogne caspia*	M	No	No	No	Not relevant to EMBA	No	Yes	
	White-tailed tropicbird	*Phaethon lepturus*	M	No	No	No	EMBA	No	Yes	
	Red-tailed tropicbird	*Phaethon rubricauda*	M	No	No	No	Not relevant to EMBA	No	Yes	
	Little tern	*Sternula albifrons*	M	No	No	No	EMBA	No	Yes	
	Bridled tern	*Onychoprion anaethetus*	M	No		No	Not relevant to EMBA	No	Yes	
	Roseate tern	*Sterna dougallii*	M	No	No	No	EMBA	No	Yes	
	Masked booby	*Sula dactylatra*	M	No	No	No	Not relevant to EMBA	No	Yes	
	Brown booby	*Sula leucogaster*	M	No	No	Marine debris	EMBA	No	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Red- footed Booby	*Sula sula*	M	No	No	No	Not relevant to EMBA	No	Yes	
	Ruddy turnstone	*Arenaria interpres*	Mw	No	No	No	None	No	Yes	
	Sanderling	*Calidris alba*	Mw	No	No	No	None	No	Yes	
	Red-necked Stint	*Calidris ruficollis*	Mw	No	No	No	None	No	Yes	
	Long-toed Stint	*Calidris subminuta*	Mw	No	No	No	None	No	Yes	
	Double Banded Plover	*Charadrius bicinctus*	Mw	No	No	No	None	No	Yes	
	Oriental Plover	*Charadrius veredus*	Mw	No	No	No	None	No	Yes	
	Swinhoe's snipe	*Gallinago megala*	Mw	No	No	No	None	No	Yes	
	Pin-tailed snipe	*Gallinago stenura*	Mw	No	No	No	None	No	Yes	
	Oriental Pratincole	*Glareola maldivarum*	Mw	No	No	No	None	No	Yes	
	Broad-billed Sandpiper	*Limicola falcinellus*	Mw	No	No	No	None	No	Yes	
	Asian Dowitcher	*Limnodromus semipalmatus*	Mw	No	No	No	None	No	Yes	
	Bar-Tailed Godwit	*Limosa lapponica*	Mw	No	No	No	None	No	Yes	
	Black-tailed godwit	*Limosa limosa*	Mw	No	No	No	None	No	Yes	
	Little Curlew	*Numenius minutus*	Mw	No	No	No	None	No	Yes	
	Whimbrel	*Numenius phaeopus*	Mw	No	No	No	None	No	Yes	

Class	Common Name	Scientific Name	EPBC Act Status	Cons Advice	Recovery Plan	Relevant Threat Abatement Plan	BIA	Operational Area Presence	EMBA presence	Relevant hazard
	Ruff	*Philomachus pugnax*	Mw	No	No	No	None	No	Yes	
	Pacific Golden Plover	*Pluvialis fulva*	Mw	No	No	No	None	No	Yes	
	Grey Plover	*Pluvialis squatarola*	Mw	No	No	No	None	No	Yes	
	Greater Crested Tern	*Thalasseus bergii*	Mw	No	No	No	None	No	Yes	
	Grey- tailed Tattler	*Tringa brevipes*	Mw	No	No	No	None	No	Yes	
	Wood Sandpiper	*Tringa glareola*	Mw	No	No	No	None	No	Yes	
	Common Greenshank	*Tringa nebularia*	Mw	No	No	No	None	No	Yes	
	Marsh Sandpiper	*Tringa stagnatilis*	Mw	No	No	No	None	No	Yes	
	Common Redshank	*Tringa totanus*	Mw	No	No	No	None	No	Yes	
	Terek Sandpiper	*Xenus cinereus*	Mw	No	No	No	None	No	Yes	

Key EPBC: WC Act; V = vulnerable; OPF = Other Protected Fauna; CE = Critically Endangered; P1 = Priority Flora and Fauna List; M = Migratory marine; Mw = Migratory wetland; S = Schedule; LC = Least concern

Table 3-4: Biologically Important Areas located within the EMBA

Class	Common Name	Scientific Name	BIA Area	Overlaps Operational Area	Overlaps EMBA
Sharks and Fish	Dwarf sawfish	Pristis clavata	Foraging	✗	✓
			Nursing	✗	✓
			Pupping	✗	✓
	Green sawfish	Pristis zijsron	Foraging	✗	✓
			Nursing	✗	✓
			Pupping	✗	✓
	Freshwater/ Largetooth sawfish	Pristis pristis	Foraging	✗	✓
			Pupping	✗	✓
	Whale shark	*Rhincodon typus*	Foraging	✗	✓
Marine mammals	Pygmy Blue whale	*Balaenoptera musculus brevicauda*	Distribution	✓	✓
			Foraging	✗	✓
			Migration	✗	✓
	Humpback whale	*Megaptera novaeangliae*	Migration	✓	✓
	Dugong	*Dugong dugon*	Breeding	✗	✓
			Calving	✗	✓
			High Density foraging	✗	✓
			Nursing	✗	✓
Turtles	Loggerhead turtle	*Caretta caretta*	Foraging	✗	✓
			Internesting Buffer	✗	✓
			Nesting	✗	✓
	Green turtle	*Chelonia mydas*	Aggregation	✗	✓
			Basking	✗	✓
			Foraging	✗	✓

Class	Common Name	Scientific Name	BIA Area	Overlaps Operational Area	Overlaps EMBA
			Internesting	✗	✓
			Internesting Buffer	✗	✓
			Mating	✗	✓
			Migration Corridor	✗	✓
			Nesting	✗	✓
	Hawksbill turtle	*Eretmochelys imbricata*	Foraging	✗	✓
			Internesting	✗	✓
			Internesting buffer	✗	✓
			Mating	✗	✓
			Migration corridor	✗	✓
			Nesting	✗	✓
	Flatback turtle	*Natator depressus*	Aggregation	✗	✓
			Foraging	✗	✓
			Internesting	✗	✓
			Internesting Buffer	✓	✓
			Mating	✗	✓
			Migration corridor	✗	✓
			Nesting	✗	✓
Seabirds	Wedge-tailed shearwater	*Ardenna pacificus*	Breeding	✓	✓
	Lesser frigatebird	*Fregata ariel*	Breeding	✗	✓
	White-tailed tropicbird	*Phaethon lepturus*	Breeding	✗	✓
	Roseate tern	*Sterna dougallii*	Breeding	✗	✓
	Fairy tern	*Sternula nereis*	Breeding	✗	✓

Class	Common Name	Scientific Name	BIA Area	Overlaps Operational Area	Overlaps EMBA
	Brown booby	*Sula leucogaster*	Breeding	✗	✓
	Lesser Crested Tern	*Thalasseus bengalensis*	Breeding	✗	✓
	Little Tern	*Sterna albifrons*	Breeding	✗	✓
			Resting	✗	✓

3.6.1 Listed Species Recovery Plans, Conservation Advice and Threat Abatement Plans

Jadestone considered recent updates to Recovery Plans, Conservation Management Plans, Threat Abatement Plans or approved Conservation Advice in place for EPBC Act-listed threatened species that may potentially occur or utilise habitat within the EMBA (Table 3-3).

Recovery Plans set out the research and management actions necessary to stop the decline of and support the recovery of listed threatened species. In addition, Threat Abatement Plans provide for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities. The Minister decides whether a threat abatement plan is required for key threatening processes listed under Section 183 of the EPBC Act.

Table 3-5 provides information on the specific requirements of the relevant conservation advice, species recovery plans and threat abatement plans that is applicable to this petroleum activity, and demonstrates how current management requirements have been taken into account during the preparation of the EP.

Table 3-5: Relevant Management Plans for Listed Threatened and Migratory Species

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
Fish, Sharks and Rays			
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Pollution and disease	7.5, 7.6
		Ecosystem effects – habitat modification	7.5, 7.6
Great white shark	Recovery plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a)	Ecosystem effects as a result of habitat modification	7.5, 7.6
Dwarf sawfish	Approved Conservation Advice on *Pristis 69lavate* (dwarf sawfish) (DEWHA, 2009) Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015a)	Habitat degradation and modification	7.5, 7.6
Freshwater/ largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (DoE, 2014b) Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015a)	Habitat degradation and modification	7.5, 7.6
Green sawfish	Approved Conservation Advice for *Pristis zijsron* (green sawfish) (DEWHA, 2008c) Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015a)	Habitat degradation and modification	7.5, 7.6
Whale shark	Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a)	Boat strike from large vessels	7.2
		Habitat disruption from mineral exploration, production and transportation	7.5, 7.6
Blind gudgeon	Approved Conservation Advice for *Milyeringa veritas* (blind gudgeon) (DEWHA,	Habitat degradation and modification including pollution	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
	2008d)		
Blind cave eel	Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (DEWHA, 2008e)	Habitat degradation and modification including pollution	7.5, 7.6
Marine Mammals			
Sei Whale	Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Anthropogenic noise and acoustic disturbance	6.2
		Habitat degradation including pollution (increasing port expansion and coastal development)	7.5, 7.6
		Pollution (persistent toxic pollutants)	7.5, 7.6
		Vessel strike	7.2
Blue whale	Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Noise Interference	6.2
		Habitat Modification	7.5, 7.6
		Vessel Disturbance/ strike	7.2
Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Anthropogenic noise and acoustic disturbance	6.2
		Habitat degradation including coastal development, port expansion and aquaculture	7.5, 7.6
		Pollution (persistent toxic pollutants)	7.5, 7.6
		Vessel strike	7.2
Southern right whale	Conservation Management Plan for the Southern Right Whale 2011 – 2021 (DSEWPaC, 2012h) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Entanglement/ marine debris	7.3
		Vessel disturbance/ strike	7.2
		Noise interference	6.2
		Habitat modification	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
Humpback whale	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Habitat degradation including coastal development and port expansion	7.5, 7.6
		Entanglement	7.3
		Vessel disturbance and strike	7.2
Bryde's whale	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	7.3
Killer whale	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	7.3
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	7.3
Antarctic minke whale	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	7.3
Dugong	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine debris	7.3
Marine Reptiles			
Short-nosed seasnake	Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (DSEWPaC, 2011a)	Habitat degradation	7.5, 7.6
Leaf-scaled seasnake	Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled seasnake) (DSEWPaC, 2011b)	Degradation of reef habitat	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
All marine turtles including: Loggerhead Turtle Green Turtle Leatherback Turtle Hawksbill Turtle Flatback Turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (DoEE, 2017) National Light Pollution Guidelines for Wildlife including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Light pollution	6.1
		Habitat modification/ loss	7.5, 7.6
		Chemical and terrestrial discharge/ deteriorating water quality	6.4, 6.5, 7.4, 7.5
		Marine debris	7.3
		Vessel disturbance/ strike	7.2
		Noise interference	6.2
Leatherback Turtle	Approved Conservation Advice on *Dermochelys coriacea* (DEWHA, 2008f)	Vessel strike	7.2
		Degradation of foraging areas	7.2, 7.3
Birds			
All seabirds and migratory shorebirds	National Light Pollution Guidelines for Wildlife including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020)	Habitat modification	7.5, 7.6
All seabirds	Draft Wildlife Conservation Plan for Seabirds (CoA, 2019)	Light pollution	6.1
		Habitat loss and degradation from pollution	7.5, 7.6
Migratory species within the combined EMBA: + Asian dowitcher; + Bar-tailed godwit; + Common greenshank; + Common sandpiper; + Oriental plover; + Oriental pratincole; + Pectoral sandpiper; and	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)	Habitat loss and degradation	7.5, 7.6
		Pollution and Contaminants	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
+ Sharp-tailed sandpiper			
Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016a) Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)	Habitat loss and habitat degradation	7.5, 7.6
		Pollution/contamination impacts	7.5, 7.6
Australian lesser noddy	Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy) (TSSC, 2015i)	Habitat modification	7.5, 7.6
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DoE, 2015c)	Habitat loss and degradation from pollution	7.5, 7.6
Great knot	Approved Conservation Advice for *Calidris tenuirostriss* (Great knot) (TSSC, 2016e) Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)	Habitat loss and degradation from pollution	7,5.7.6
Greater sand plover	Approved Conservation Advice for *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016b) Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)	Habitat loss and habitat degradation	7.5, 7.6
		Pollutant/ contaminant impacts	7.5, 7.6
Lesser sand plover	Approved Conservation Advice for *Charadrius mongolus* (Lesser sand plover) (TSSC, 2016d) Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)	Habitat loss and habitat degradation	7.5, 7.6
		Pollutant/ contaminant impacts	7.5, 7.6
Northern Siberian bar-tailed godwit	Approved Conservation Advice for *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian) (TSSC, 2016c)	Habitat loss and habitat degradation	7.5, 7.6
		Pollutant/ contaminant impacts	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
Southern giant petrel	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine pollution	7.5, 7.6
Eastern curlew	Approved Conservation Advice *for Numenius madagascariensis* (eastern curlew) (DoE, 2015d)	Habitat loss and degradation from pollution	7.5, 7.6
Abbott's booby	Approved Conservation Advice for the Abbott's booby *Papasula abbotti* (TSSC, 2020a)	Habitat loss, disturbance and modifications	7.5, 7.6
		Marine debris - plastics	7.3
Christmas Island white-tailed tropicbird	Approved Conservation Advice for *Phaethon lepturus fulvus* white-tailed tropicbird (Christmas Island) (DoE, 2014c)	None listed relevant to the Activity	N/A
Soft-plumaged petrel	Approved Conservation Advice for *Pterodroma mollis* (soft-plumaged petrel) (TSSC, 2015h)	None listed relevant to the Activity	N/A
Australian painted snipe	Approved Conservation Advice on *Rostratula australis* (Australian painted snipe) (DSEWPaC, 2013b)	None listed relevant to the Activity	N/A
		Oil spills	7.5, 7.6
		Marine plastics/ debris	7.3
		Marine pollution	7.5, 7.6
Australian fairy tern	Approved Conservation Advice on *Sternula*	Oil spills	7.5, 7.6

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
	nereis nereis (fairy tern) (TSSC, 2011)		
Shy albatross	Conservation Advice *Thalassarche cauta* Shy Albatross (TSSC, 2020b) National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine plastics/ debris	7.3
		Marine pollution	7.5, 7.6
White-capped albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	Marine pollution	7.5, 7.6
		Marine debris	7.3
Black-browed albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018)	Marine pollution	7.5, 7.6
		Marine debris	7.3

Species or Group	Relevant Plan/ Conservation Advice	Threats and or Management Strategies relevant to the Activity	Addressed (where relevant) in EP Section
	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (DoEE, 2018)		
Campbell albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018)	Marine pollution	7.5, 7.6
Flesh-footed Shearwater	Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (DoEE, 2018)	Marine pollution	7.5, 7.6
Wedge-tailed Shearwater	Threat Abatement Plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (CoA, 2018) Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (DoEE, 2018)	Marine pollution	7.5, 7.6
Brown Booby	Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans (DoEE, 2018)	Marine debris	7.3

3.6.2 Fish

Fifteen species of EPBC listed fish and rays have been identified as potentially occurring within the EMBA. Of these, four species have a BIA that overlaps with the EMBA including the; whale shark, green, dwarf and freshwater sawfishes (Figure 3-6 and Table 3-4).

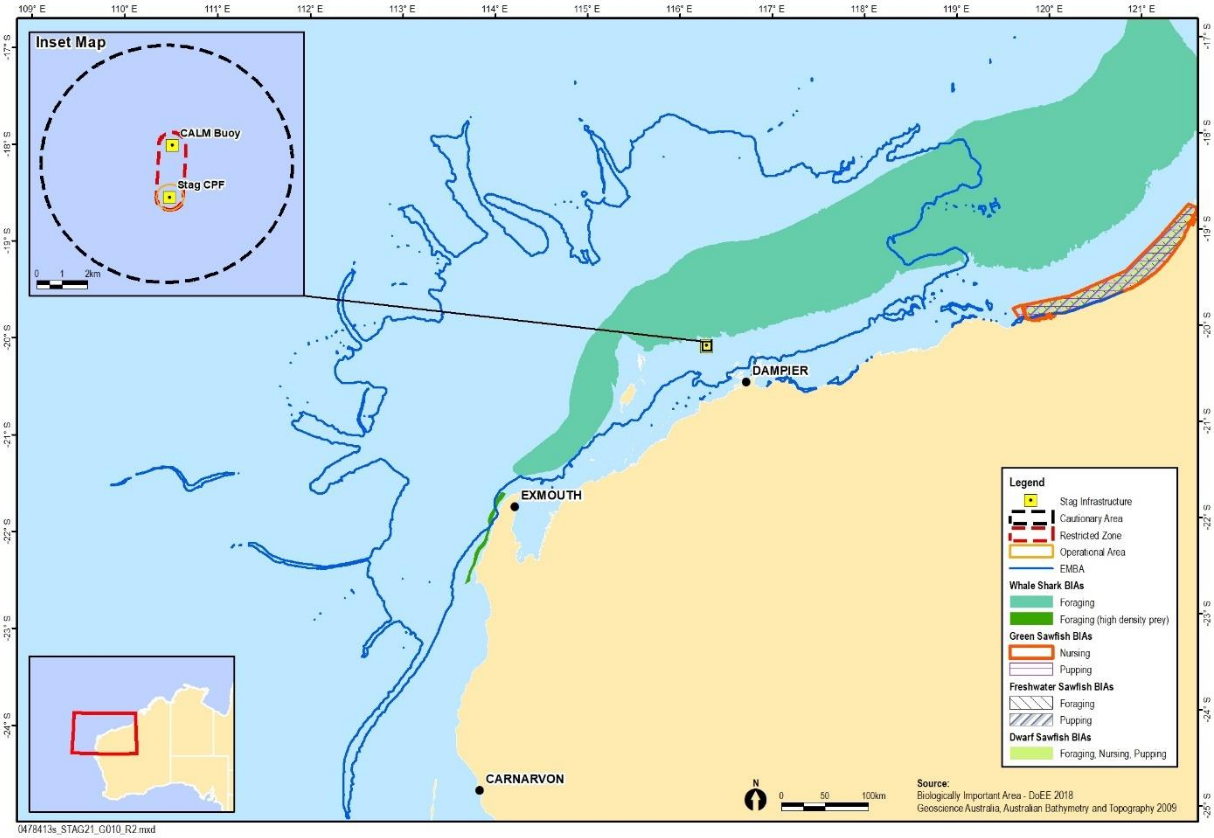

Figure 3-6: **Biologically Important Areas for Sharks and Fish within the EMBA**

<u>Grey Nurse Shark</u>

In Australia, the grey nurse shark has an inshore coastal distribution primarily in sub-tropical to cool temperate waters on the continental shelf. There are two separate, genetically distinct grey nurse shark populations in Australian waters—one on the east coast and one on the west coast (Stow et al., 2006 as cited in CoA 2014). The range of the west coast population is not well known; however, records indicate that the species is widely distributed from the NWS (including coastal waters in Exmouth Gulf), south to the Great Australian Bight (CoA 2014).

It is thought that individuals have a high degree of site fidelity, although some studies have suggested that the species exhibits some migratory characteristics moving between different habitats and localities (McAuley, 2004).

Grey Nurse Sharks are often observed aggregating above the seabed (at depths 10–40 m) near deep sandy-bottomed gutters or rocky caves in the vicinity of inshore rocky reefs and islands (CoA 2014). Grey nurse sharks have also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf (Pollard et al. 1996). No key aggregation sites have been identified in WA waters.

As outlined in the Recovery Plan for the Grey Nurse Shark (Carcharias taurus) 2014 (DoEE 2014), the principal current threats to the grey nurse shark in Australia are:

Mortality related to incidental capture by commercial and recreational fisheries; and

Mortality related to shark control activities such as beach meshing or drum lining.

Although individuals may be present in the EMBA, based on their distribution it is likely limited to individuals only.

White Shark

The great white shark (*Carcharodon carcharias*) is listed as vulnerable under the EPBC Act and may occur within the spill trajectory area as they are known to prey on humpback whales and have been recorded in NWC waters during humpback migrations. Study into great white shark populations is difficult (Cailliet, 1996) given the uncertainty about their movements, emigration, immigration and difficulty in estimating the rates of natural or fishing mortality. In Australia, great white sharks have been recorded from central Queensland around the south coast to north-west WA but may occur further north on both coasts (Last and Stevens, 2009). They are widely but not evenly distributed in Australian waters and is considered uncommon to rare compared to most other large sharks (CITES, 2004). Great white sharks can be found from close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope areas (Pogonoski et al., 2002). They also make open ocean excursions and can cross ocean basins (for instance from South Africa to the western coast of Australia and from the eastern coast of Australia to New Zealand). Great white sharks are often found in regions with high prey density, such as pinniped colonies (DEWHA, 2009).

Dwarf Sawfish

The dwarf sawfish (*Pristis clavata*) is listed as vulnerable under the EPBC Act. The Australian distribution of the dwarf sawfish is considered to extend across northern Australia and along the Kimberley and Pilbara coasts (Last and Stevens, 2009; Stevens et al., 2005). The majority of records of dwarf sawfish in WA have come from shallow estuarine waters of the Kimberley region which are believed to be nursery areas, with immature juveniles remaining in these areas up until three years of age (Thorburn et al., 2004). Sawfish regularly use the tidal creeks and mangrove areas of Roebuck Bay, within the EMBA, for breeding and refuge (Bennelongia, 2009). The updated sawfish recovery plan (CoA 2015) indicates where pupping is known and likely to occur along the Pilbara coastline, with main areas within the EMBA being along Eighty Mile Beach. A foraging, pupping and nursing BIA overlaps the EMBA (Figure 3-6 and Table 3-4). Similarly, the Recovery Plan indicates that adults are known to occur along the coast north of Exmouth and within the EMBA and operational area.

Freshwater and Green Sawfish

In Australian waters, green sawfish have historically been recorded in the coastal waters off Broome, Western Australia, around northern Australia and down the east coast as far as Jervis Bay, NSW (Stevens et al., 2005). Important areas for freshwater sawfishes include King Sound, and the Fitzroy, Durack, Robinson and Ord rivers. Both species are wider ranging than the dwarf sawfish.

Sawfishes generally inhabit inshore coastal, estuarine and riverine environments. The freshwater sawfish has been recorded in north-west Australia from rivers (including isolated water holes), estuaries and marine environments (Stevens et al. 2005). Newborns and juveniles primarily occur in the freshwater reaches of rivers and in estuaries, while most adult freshwater sawfish have been recorded in marine and estuarine environments (Peverell 2005, Thorburn et al. 2007). It is believed that mature freshwater sawfish enter less saline waters during the wet season to give birth (Peverell 2005) and freshwater river reaches play an important role as nursery areas (DoE 2014c).

The green sawfish inhabits muddy bottom habitats and enters estuaries (Allen, 1997; Stead, 1963). It has been recorded in inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches (Peverell et al., 2004; Stevens et al., 2005; Thorburn et al., 2004). Stead (1963) reported that this species was frequently found in shallow water. Green sawfish have been recorded in very shallow water (<1 m) to offshore trawl grounds in over 70 m of water (Stevens et al., 2005).

Smaller specimens (<2.5 m in length) are more common in foreshore and offshore coastal waters (Thorburn et al., 2004), as well as estuaries and river mouths at slightly reduced salinities, but do not venture into freshwater. Larger individuals (>2.5 m in length) are found in both inshore and offshore waters.

The updated sawfish recovery plan (CoA 2015) indicates where pupping is known and likely to occur along the Pilbara coastline, with main areas within the EMBA being along Eighty Mile Beach. There is an identified foraging, nursing and pupping BIA for the Green Sawfish and a foraging and pupping BIA for the Freshwater Sawfish (Figure 3-6 and Table 3-4). Similarly, the Recovery Plan indicates that adults are known to occur along the coast north of Exmouth within the EMBA and operational area.

Principal threats to sawfish species are fishing activities (by-catch, traditional or illegal fishing) and habitat degradations or modification.

Whale Shark

The whale shark (*Rhincodon typus*) is an oceanic and coastal, pelagic fish, generally found in tropical areas where the surface temperature is 21–25°C. It is a filter feeder and, commonly ranges in size from 4–10 m (Colman, 1997). This species was listed as Vulnerable under the EPBC Act in 2001 and is also classified as Vulnerable on the World Conservation Union's Red List of Threatened Species (IUCN, 2012). In WA, whale sharks are protected under the Wildlife Conservation Act 1950, the Conservation and Land Management Act 1984 and the Fish Resources Management Act 1994.

There is a general lack of knowledge on many aspects of whale shark biology, including definitive migration patterns. They are normally oceanic and cosmopolitan in their distribution and are known to aggregate in the reef front waters adjacent to the Ningaloo Reef between March to June (Colman, 1997; Wilson et al., 2006) with the highest frequency of sightings occurring in April (Wilson et al., 2001). However, the season is variable and individual whale sharks have been recorded at other times of the year. The EMBA overlaps a foraging and high density foraging BIA (Figure 3-6 and Table 3-4), While the species spends the majority of its time in deeper water, it is also encountered close to or at the surface.

Whale shark presence coincides with the coral mass spawning period, when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to the reef. Estimates of the size of the population participating in the Ningaloo aggregation are between 300 and 500 individuals (Meekan et al., 2006).

Preliminary research on the migration patterns of whale sharks in the western Indian Ocean, and isolated and infrequent observations of individuals, indicate that a small number of the WA population migrate through the NWMR. Wilson et al. (2006) tagged 19 whale sharks in 2003 and 2004, with long-term movements patterns successfully recorded from six individuals. All travelled north-east into the Indian Ocean after departing Ningaloo Reef, with one tracked to Ashmore Reef and another to Scott Reef.

The most significant threat to whale sharks is intentional and unintentional mortality from fishing outside of Australian waters. In Australian waters, threats to the recovery of the species include boat strike from large vessels and habitat disruption from mineral exploration, production and transportation. Other lesser threats include disturbance from domestic tourism operations, marine debris and climate change.

Ongoing threats to whale sharks, together with life history characteristics; including slow growth, late maturation and extended longevity (Colman, 1997); means the whale shark remains susceptible to declines across its international range.

Manta Rays

The giant and reef manta rays can be found throughout the waters of WA. They are listed as migratory and may be found in locations such as Ningaloo. The giant manta ray appears to be a seasonal visitor to coastal or offshore sites. Giant manta rays are often seen aggregating in large numbers to feed, mate, or clean. Sightings of these giant rays are often seasonal or sporadic but in a few locations their presence is a more common occurrence. This species is not regularly encountered in large numbers and, unlike some other rays do not often appear in large schools (>30 individuals) when feeding. Overall, they are encountered with far less frequency than the smaller manta species, despite having a larger distribution across the globe (IUCN, 2014b).

Narrow sawfish

The narrow sawfish (*Anoxypristis cuspidate*) is listed as Migratory under the EPBC Act. It is a marine or marginal (brackish water) species found from inshore waters to a depth of 40 m (Compagno et al. 2006). Though details of its ecology are not precisely known, it probably spends most of its time on or near the bottom in shallow coastal waters and estuaries. A study showed the narrow sawfish to be the most abundant amongst the sawfish sampled in the Gulf of Carpentaria (Peverell, 2005) which holds some consistency with the offshore distribution of the species as shown by a study of Northern Prawn Fishery by-catch. Peverell (2005) also used catch data of offshore surface net fisheries to conclude that narrow sawfish also inhabit the mid-water column and can thus be described as a benthopelagic animal. The narrow sawfish is known to form aggregations of mature females during the months of October to November. Its Australian distribution is unclear though it is most common in the Gulf of Carpentaria with southward ranges extending to Broad Sound in Queensland and the Pilbara Coast (circa 116°E), Western Australia (Last & Stevens, 2009).

Oceanic White-tip Shark

The oceanic whitetip shark (*Carcharhinus longimanus*) is listed as migratory under the EPBC Act. The oceanic whitetip shark is widespread throughout tropical and subtropical waters of the world (30° N to 35° S) (IUCN 2020). They are an oceanic and pelagic species that regularly occurs in waters of 18 to 28°C, usually >20°C (IUCN 2020). Within Australian waters, they are found from Cape Leeuwin (Western Australia) through parts of the Northern Territory, down the east coast of Queensland and New South Wales to Sydney (Last and Stevens 2009). They are usually found in surface waters, though can reach depths of >180 m (Castro et al. 1999). They have occasionally been recorded inshore but are more typically found offshore or around oceanic islands and areas with narrow continental shelves (Fourmanoir 1961, Last and Stevens 1994).

Blind Gudgeon and Blind Cave Eel

Both the blind gudgeon (Milyeringa veritas) and blind cave eel (*Ophisternon candidum*) are known to occur on the Cape Range Peninsula (in the Central Western Shelf Transition) (Humphreys and Feinberg 1995), and a related species of the genus Milyeringa, the Barrow cave gudgeon (*Milyeringa justitia*) has also been noted at Barrow Island (Humphreys 1999). The Barrow cave gudgeon is listed as Vulnerable under the WA EPBC Act. They have been recorded in waters ranging from fresh to seawater at depths of up to 33 m in caves and 50 m in wells and bores. Both species are restricted to either caves or groundwater (Humphreys and Blyth 1994) and are the only two vertebrate animals known from Australia for this (DoE 2014a).

Shortfin and Longfin Mako Shark

The shortfin mako and longfin mako sharks are listed as Migratory under the EPBC Act. The longfin mako is a widely distributed but rarely encountered oceanic shark that ranges from Geraldton around the north coast to at least Port Stephens in New South Wales (DSEWPaC 2012). The shortfin mako is an oceanic and pelagic species, although they are occasionally seen inshore. They are found throughout temperate seas but are rarely found in waters colder than 16°C.

Porbeagle Mackerel Shark

The Porbeagle is wide-ranging and inhabits temperate, subarctic and subantarctic waters of the North Atlantic and Southern Hemisphere (Francis et al. 2002). In Australia, the species occurs in waters from southern Queensland to south-west Australia (Last and Stevens 2009). Animals typically occur in oceanic waters off the continental shelf, although they occasionally enter coastal waters (Francis et al. 2002).

The Porbeagle primarily inhabits oceanic waters and areas around the edge of the continental shelf although they occasionally move into coastal waters, but these movements are temporary (Campana and Joyce 2004; Francis et al. 2002). Individuals are known to undertake seasonal migrations, possibly in search of food, although the timing and details of these migratory movements are not well-understood (Saunders et al. 2011).

Pipefish and seahorse (Syngnathidae)

Other EPBC Act protected marine species that may occur within the EMBA include various species of pipefishes and seahorses (Family Syngnathidae). Knowledge about the distribution, abundance and ecology of both syngnathids and solenostomids is limited (DSEWPaC 2012). In tropical areas such as the EMBA, species are primarily found among coral reefs (Foster & Vincent 2004; Scales 2010).

3.6.3 Marine Mammals

Marine mammals occur in the waters of the Stag Facility, some being seasonal visitors while others occur at low densities year- round. Marine mammals that may occur in the region include cetaceans (whales, porpoises and dolphins) and dugongs. A search of the EPBC Act protected matters database (Appendix B) revealed 32 cetaceans that may occur within the EMBA. The search identified four threatened marine mammal species that may occur within the EMBA, including two species listed as vulnerable, the sei whale (*Balaenoptera borealis*) and fin whale (*Balaenoptera physalus*), and two species listed as endangered, the blue whale (*Balaenoptera musculus)* and southern right whale (*Eubalaena australis*). As of February 2022, humpback whales were removed from the Vulnerable list as it was determined that the species is no longer eligible for inclusion in any category of the list. It is however still listed as migratory under the EPBC Act. Although the humpback whale was included in the Protected Matters Search undertaken in December 2021 it has since been excluded from any threatened species counts in this EP. Thirteen marine mammals were also identified as migratory including the humpback whale.

The blue whale, humpback whale and dugong have identified BIAs that overlap the EMBA. Further information on relevant BIAs for these species is provided in Figure 3-7 and Table 3-4. In addition, seven marine mammals were identified as migratory.

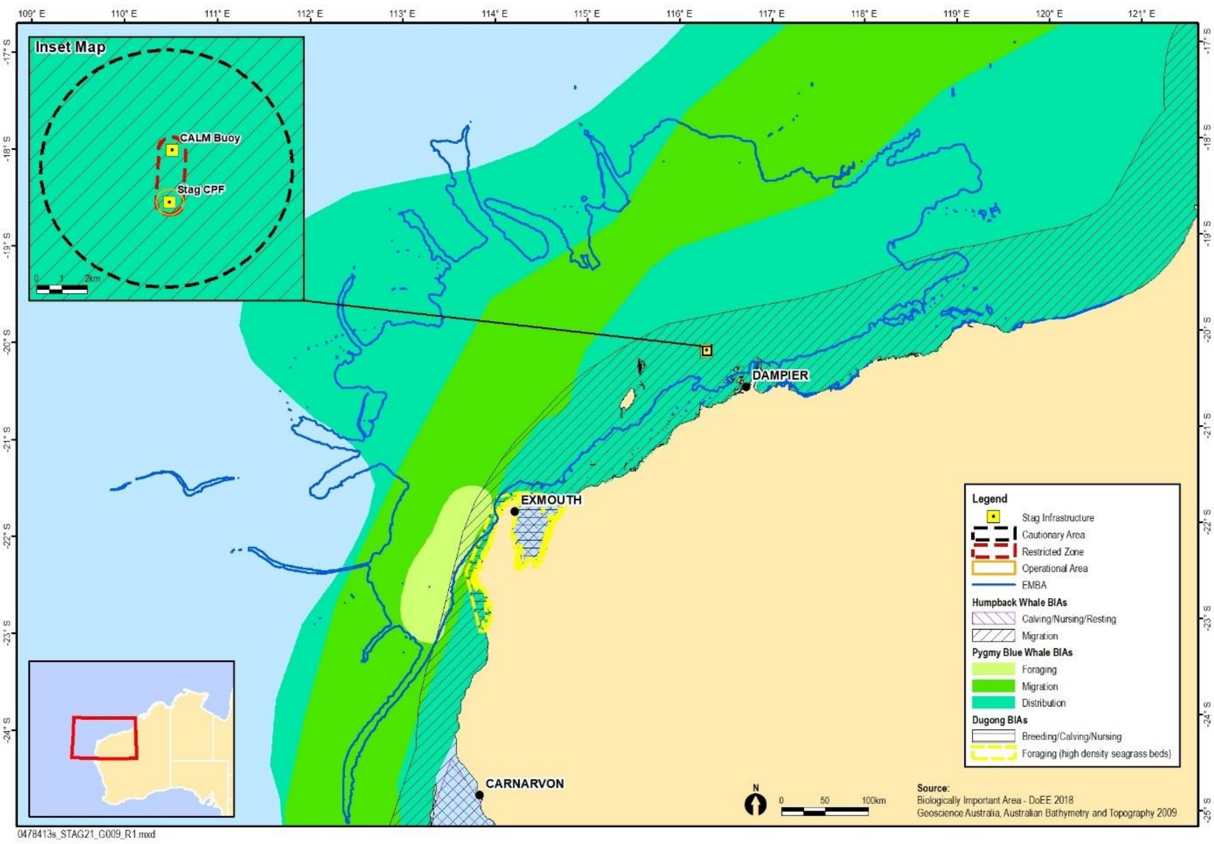

Figure 3-7: Biologically Important Areas for Marine Mammals within the EMBA

<u>Blue Whale</u>

Blue whales are found in all oceans of the world. They are the largest living animal and can grow to a length of over 30 m and weigh an average of 100–120 t. There are two recognised subspecies in Australia: the 'true' blue whale (Balaenoptera musculus intermedia) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda)* (DSEWPaC, 2012d). Both of these species are covered by the Blue Whale Conservation Management Plan 2015 (DoEE 2015). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA, 2008a, b). As southern blue whales feed predominantly in polar waters it has been suggested that all blue whales sighted in Australian waters are pygmy blue whales (DEH, 2005). During summer–autumn true blue whales feed mainly in the Antarctic, mostly on krill, while pygmy blue whales are thought to feed in productive regions in temperate latitudes (Branch *et al*., 2007).

The Perth Canyon is the only area so far identified off the WA coast where pygmy blue whales aggregate with some predictability. The area represents a significant feeding ground for pygmy blue whales between January and April, with aerial surveys between 1999 and 2004 recording an average of 30 individuals at the peak of the season (March–May) (Jenner et al.,2002; McCauley et al., 2004). Acoustic detections suggest that true blue whales also over-winter around the Perth Canyon and head south in mid-October (McCauley et al., 2004).

The pygmy blue whale has three identified BIAs: (a foraging and migration) overlaps the EMBA and a distribution BIA overlaps both the EMBA and operational area (Figure 3-7 and Table 3-4). However, Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DSEWPaC, 2012d). The blue whale is rarely present in large numbers outside recognised aggregation areas. Chevron's Wheatstone project cetacean monitoring studies indicated that during their southern migration blue whales were recorded between the 750 m and the 850 m isobaths and between the 300 m and the 350 m isobaths (RPS, 2010). These data also showed a seasonal migration pattern further west from May to August (moving northwards), with a southwards migration occurring between November and December (RPS, 2010). These findings are supported by acoustic detections undertaken off the Montebello Islands which showed a northerly pulse from late March to early August with peak migration in June and July, and a pulse of southerly transiting whales from early October to late November, with a peak migration period occurring from early November to early December (McCauley and Jenner, 2010).

Tagging surveys have shown pygmy blue whales migrating northward relatively near to the Australian coastline (100 km) until reaching North-West Cape after which they travelled offshore (240 km) to Indonesia. Passive acoustic data documented pygmy blue whales migrating along the Western Australian shelf break (Woodside 2012). The National Conservation Values Atlas has identified the pygmy whale migration pathway on the continental shelf edge at depth of 500 to 1,000 m (Figure 3-7) (McCauley & Jenner 2010).

Humpback Whale

Humpback whales are moderately large baleen whales that occur throughout Australian waters and are the most commonly sighted whale in the NWMR (DSEWPaC, 2012e).

The WA humpback whale population (known as the Group IV population) is genetically distinct from the eastern Australian population and was severely depleted by whaling activities. The population was estimated at 12,000 to 16,000 individuals in 1934 and continued to decline to an estimated 800 individuals prior to the moratorium on whaling in the southern hemisphere in 1962 (Chittleborough, 1965). More recent population estimates have suggested whale numbers have increased to ~ 28,830 in 2008 (Hedley et al., 2011 as cited in DoE 2015). Numbers have increased further in recent years and the Action Plan for Australian Mammals 2012 by Woinarski et al., 2014, and a recent paper from Bejder et al., 2015 recommend that humpback whales no longer meet any criteria for listing as threatened under the EPBC Act. As of February 2022, humpback whales were removed from the Vulnerable list as it was determined that the species is no longer eligible for inclusion in any category of the list. Despite removal from the threatened species list, it will remain a Migratory species under the EPBC Act and BIAs are still recognised for the species.

Humpback whales migrate annually between summer feeding grounds in Antarctica and breeding aggregation areas in Southern Kimberley between Broome and the northern end of Camden Sound. There is an identified migratory BIA that overlap both the EMBA and operational area (Figure 3-7 and Table 3-4).

The humpback whale migration pathway is within the continental shelf boundary or 200 m bathymetry along the WA coastline (DoE, 2015). However actual sightings recorded by Jenner et al (2001) and Double et al. (2010 and 2012) indicate that the route is actually much closer to shore, particularly along the Pilbara coast, with migrating whales tending to travel within 50 km of the coast between North-West Cape and Camden Sound.

Humpback whales pass north along the waters west of Barrow Island to the Montebello Islands during their annual winter migration from the Antarctic. Once past the Montebello Islands their migration route heads east towards their breeding grounds in the Kimberley. The northward migration past Montebello and Barrow Islands generally occurs from mid-July with the peak in late July, though this can vary by up to three weeks. Unlike the northern migration, which tends to follow the deeper water of the continental shelf, the southward migration concentrates whales closer to the mainland with a peak Aug–mid-Sep (DoE 2015).

Major calving areas have been identified in the Kimberley region and particularly between Lacepede Islands (16°8S) and Camden Sound (15°38S) (Jenner et al., 2001) which are more than 900 km from the Stag Operational Area.

Whales may travel through the operational area on a seasonal basis as part of their migratory movements. The Stag Platform is more than 900 km from core calving grounds and more than 250 km from identified resting areas at Exmouth Gulf and southern Kimberley. As such, whales may be present in the area as part of the season migration.

Indo-Pacific Humpback dolphin

The Indo-pacific humpback dolphin is typically found in water less than 20m deep but has been recorded in water up to 40m deep. This species is generally found in association with river mouths, mangroves, tidal channels and inshore reefs (DoEE 2016a). This species of dolphin is known to have resident groups that forage, feed, breed and calve in the state waters of Roebuck Bay and areas further north (DoEE 2016a).

No BIA for the Indo-pacific humpback dolphin is located within the EMBA or Operational Area, although a foraging and breeding BIA is located in the shallower waters off Broome.

Spotted Bottlenose dolphin

The Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) (Arafura / Timor Sea populations) is generally considered to be a warm water subspecies of the spotted bottlenose dolphin, occurring in shallow (often <10m deep) inshore waters (Bannister et al., 1996; Hale et al., 2000). The known distribution of the Indo-Pacific bottlenose dolphin extends from Shark Bay north to the western edge of the Gulf of Carpentaria in Australia (DoEE, 2016b).

No BIA for the spotted bottlenose dolphin is located within the EMBA or Operational Area, although a foraging BIA is located in the shallower waters off Broome.

Sei Whale

Sei whales have been infrequently recorded in Australian waters (Bannister et al., 1996) which could be due to the similarity in appearance of sei whales and bryde's whales leading to incorrect recordings. There are no known mating or calving locations in Australian waters (Parker, 1978). The species is migratory, moving between Australian waters and Antarctic feeding areas but their movements are unpredictable and not well documented. They have been sighted inshore (in the proximity of the Bonney upwelling, Victoria) as well as in deeper offshore waters and have only been sighted in summer and autumn.

Fin Whale

Fin whales are listed as vulnerable and migratory under the EPBC Act. The fin whale is the second largest species after the blue whale. Fin whale distribution in Australia is known primarily from stranding events and whaling records and the whales are thought to be present along the western coast of Australia to NSW. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving locations in Australian waters (Morrice et al., 2004). The migration routes and location of winter breeding grounds are uncertain, but presence has been detected in summer and autumn months.

Southern Right whale

Southern right whales from Australian populations probably forage between about 40°S and 65°S, generally south of Australia. In the region of the Sub-Tropical Front (41–44°S) they mainly consume copepods, while at higher latitudes (south of 50°S) krill is the main prey item. The species feeds in the Southern Ocean in summer, moving close to shore in winter. Right whales feed by surface skimming or shallow dives, trapping plankton on fine baleen fibres. The migratory paths between calving and feeding areas are not well understood (CoA 2012).

The Conservation Management Plan for the Southern Right Whale 2011-2021 (CoA 2013) indicates that the core coastal range for southern right whale is from Perth along the southern coastline to Sydney. Although sightings have been recorded as far north as Exmouth these are rare (Bannister et al. 1996) and no BIA are located in the waters surrounding the Operational Area or the EMBA.

Given that major calving areas and aggregations occur in proximity to the Great Australian Bight, southern right whales are unlikely to be present in high numbers within the operational area or EMBA, and any occurrence would be infrequent and limited to transiting individuals.

Australian Snubfin Dolphin

The snubfin dolphin (*Orcaella heinsohni*) is known to occur within the waters off northern Australia, extending north from Broome in Western Australia to the Brisbane River in Queensland (DoEE 2016c). Surveys have indicated that the species is typically found in protected shallow nearshore waters, generally less than 20 m deep, adjacent to river and creek mouths close to seagrass beds (DoEE 2016c). The snubfin dolphin was not recorded during any of the aerial surveys undertaken along the Dampier Peninsula coastline in the vicinity of James Price Point but were observed in Roebuck Bay from vessels on several occasions (RPS, 2010b). Based on the extensive survey effort and amenable conditions within the James Price Point coastal area during the survey, it is concluded that this species is seldom found outside of shallow and sheltered bays and inlets (DSD 2010). No BIA for the Australian snubnose dolphin is located within the Operational Area EMBA, although a foraging BIA is located in the shallower waters off Broome.

Dugong

Dugongs are listed as a Migratory species under the EPBC Act and protected under Schedule 4 of the WA Wildlife Conservation Act. They are also listed on the Appendix 1 of the Convention of International Trade in Endangered Species (CITES) and on Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals 1979. Dugongs (*Dugong dugon*) are large herbivorous marine mammals (up to 3 metres) that feed off seagrass and generally inhabit coastal areas in shallow waters (less than 5 m).

Dugong distribution and movement is based on the abundance, size and species of seagrass meadow. Key populations along the WA coast are principally located at: Shark Bay (the largest resident population in Australia), Ningaloo Marine Park, the Pilbara coast and offshore areas including Montebello/Barrow/Lowendal Islands, and further north at Eighty Mile Beach and off the Kimberley Coast, particularly Roebuck Bay and Dampier Peninsula (Marsh et al. 2002; DSEWPaC 2012).

A high density foraging BIA (seagrass beds) and a Breeding/ Calving / Nursing BIA is located in the waters around Ningaloo Reef and Exmouth Gulf. . A foraging and migration BIA, is also located in Roebuck Bay, this is located outside the EMBA however.

Sperm Whale

Sperm whales typically occur in deep waters (greater than 200m) off the continental shelf along the southern coastline between Cape Leeuwin and Esperance (Bannister et al. 1996). Although there is a lack of detailed information on migration timings, sperm whales are known to migrate northwards in winter and southwards in summer. Sperm whales have been recorded in deep water off the North-west Cape on the west coast of Western Australia (RPS, 2010b), and appear to occasionally venture into shallower waters in other areas (RPS, 2010b). No BIAs have been identified in the waters surrounding the Operational Area or the EMBA.

Given that major foraging areas occur off Perth and in proximity to the Great Australian Bight, sperm whales are unlikely to be present in high numbers within the operational area or EMBA, and any occurrence would be infrequent and limited to transiting individuals.

Other whale species

Other cetacean species whose broad distributions overlap with the operational area and EMBA include whales that are infrequently observed and usually restricted to cooler or deep waters such as Bryde's whales, Antarctic minke and killer whales. As no BIA for these species are known in the region, and they are generally restricted to deeper waters, it is unlikely they will be encountered in significant numbers.

3.6.4 Marine Reptiles

Marine turtles and sea snakes have been identified as potentially occurring within the EMBA.

Marine Turtles

Five species of threatened marine turtles may occur within the EMBA, three of these species are classed as threatened-vulnerable under the EPBC Act, the hawksbill (*Eretmochelys imbricata*), flatback (*Natator depressus*) and green turtles (*Chelonia mydas*) with two species, the loggerhead (*Caretta caretta*) and leatherback turtle (*Dermochelys coriacia*), classed as threatened-endangered. Green, flatback, hawksbill, and loggerhead turtles nest on the sandy beaches of offshore islands and the mainland within the Stag Facility EMBA. The leatherback turtle may also visit the open waters of the region.

These species are all identified within the Recovery Plan for Marine Turtles in Australia (DoEE, 2017). The Operational Area overlaps with nesting and internesting areas identified as habitat critical to the survival of the Flatback Turtles, while Green, Loggerhead and Hawksbill turtles have critical nesting habitat areas located within the EMBA.

The nearest turtle nesting sites to the operational area are located ~ 35 km to the south-east at Dampier Archipelago and ~ 60 km to the south-west at Barrow, Montebello and Lowendal Islands. Table 3-6 outlines turtle activity within the Operational Area and EMBA and the figures below show BIAs specific to turtle species.

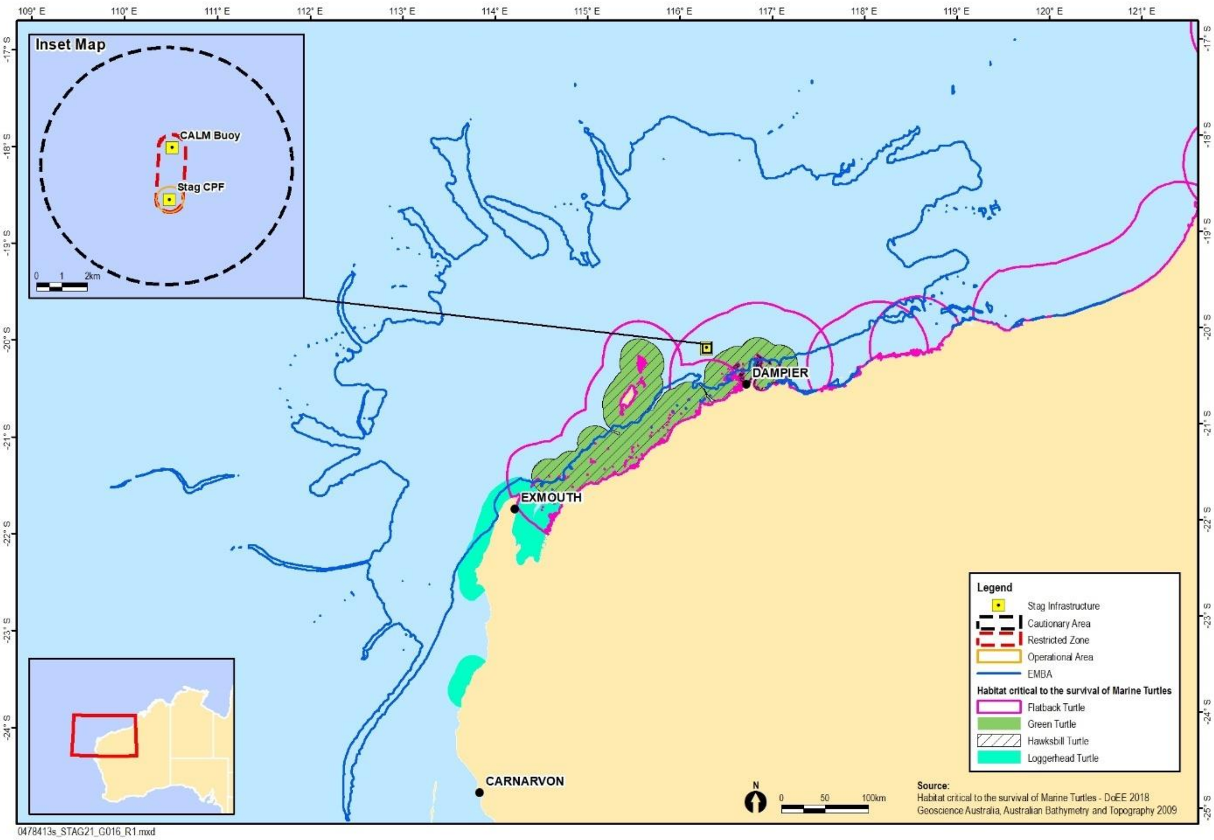

Figure 3-8: Habitat critical to the survival of marine turtles

<u>Loggerhead turtles</u>

WA supports one genetic stock of loggerhead turtles with nesting encompassing Muiron Islands, Ningaloo Coast south to about Carnarvon and islands near Shark Bay, including Dirk Hartog Island (Limpus, 2008b), with occasional nesting recorded from Varanus and Rosemary Islands (DSEWPaC, 2012f). One nesting loggerhead has been tagged on Varanus Island since 1986 (Apache, 1999). Low numbers of loggerheads have also been observed on Barrow Island (Chevron, 2008). The annual nesting population in the region is thought to be in the several thousand (Limpus, 2008b). Foraging, internesting buffer and nesting BIAs have been identified and overlap the EMBA (Figure 3-9). The closest known breeding/nesting grounds to the Stag Facility are Rosemary Island (Dampier Archipelago) and Barrow and Varanus Islands. Loggerhead Turtles regularly use Roebuck Bay as a seasonal feeding and transit area on migration (Bennelongia, 2009). Interestingly, the Draft Turtle Recovery Plan (CoA 2016) only identified Gnarloo and the Ningaloo coast as nesting locations.

Aerial surveys conducted in 2000 and 2001 in the Exmouth region recorded only 12 sightings in Commonwealth waters and these turtles were most likely loggerheads (BHPB, 2005). Within the Ningaloo Marine Park, loggerhead turtles tend to nest in higher proportions in the southern areas of the reserves (CALM, 2005a).

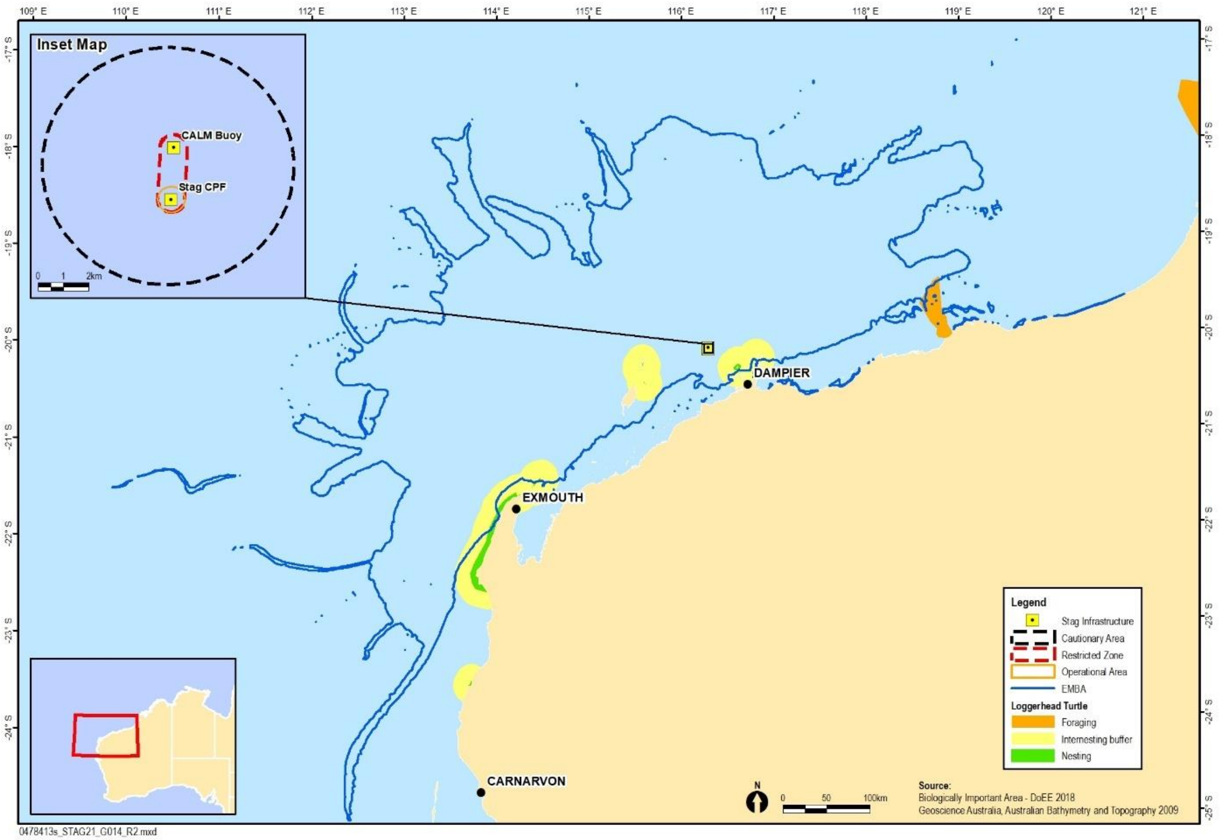

Figure 3-9: Biologically Important Areas for the Loggerhead Turtle

<u>Green turtles</u>

Green turtles are the most widespread and abundant turtle species in WA waters, nesting from the Ningaloo coast to the Lacepede Islands and out to Scott and Ashmore Reefs (Prince, 1994; Limpus, 2008a; DSEWPaC, 2012f), with three distinct breeding stocks: the NWS stock, the Scott Reef stock and the Ashmore Stock (Dethmers, et al., 2006; Limpus, 2008a). The NWS population is one of the largest in the world and the most significant rookery is the western side of Barrow Island (Prince, 1994; Limpus, 2008a). Other principal rookeries include the Lacepede Islands, Montebello Islands, North-West Cape and Browse Island (Prince, 1994; Limpus, 2008a). Numerous other small rookeries also occur in WA. The green turtle is also known to breed in large numbers in the dunes above the extensive beaches found on Serrurier Island, with counts indicating the island supports the second largest rookery in the Pilbara (Oliver, 1990). Low numbers of green turtles have also been observed nesting on Airlie Island and Varanus Island (Pendoley Environmental, 2011). The closest known breeding/nesting grounds to the Stag Facility are Barrow, Montebello and Varanus Islands.

Green turtle nesting abundance fluctuates significantly from year to year, depending on environmental variables and food availability at feeding sites. In an aerial survey of Pilbara waters in April 2000, Prince (2001) estimated a mixed species population of 57,000 turtles of which most were green turtles. Several BIAs (aggregation, basking, foraging, internesting, internesting buffer, mating, migration corridor and nesting) have been identified that overlap the EMBA (Table 3-4 and Figure 3-10). No BIAs overlap the Operational Area

Chevron (2005, 2008) reported that green turtles nest predominantly on the sandy west coast beaches of Barrow Island. In addition to nesting, green turtles mate and forage close to Barrow Island during the summer breeding season. Aggregations of green turtles have been reported from the shallow areas along the west coast of Barrow Island, with turtles foraging on and around nearshore reefs. Green turtles have also been observed to the south and south-east of Barrow Island, around dugong Reef and over the Barrow Shoals

(Chevron, 2005, 2008). The Recovery Plan for Marine Turtles in Australia (CoA 2017a) identifies Barrow Island and all waters within a 20km radius of the island as critical habitat to the survival of the green turtles.

Nesting of green turtles has been recorded from August to March on Serrurier Island (Woodside, 2002), from December to March along coast adjacent to Ningaloo (CALM, 2005a) and from October to February on Varanus Island (Pendoley Environmental, 2011). On Barrow Island, mating aggregations may commence from October with peak nesting from December to January and hatchlings emerging through summer and early autumn, although nesting does occur year-round (Chevron, 2005, 2008; Pendoley, 2005). The Draft Turtle Recovery Plan (CoA 2016) identifies the nesting period the NWS stock as November to March with peaks in January and February.

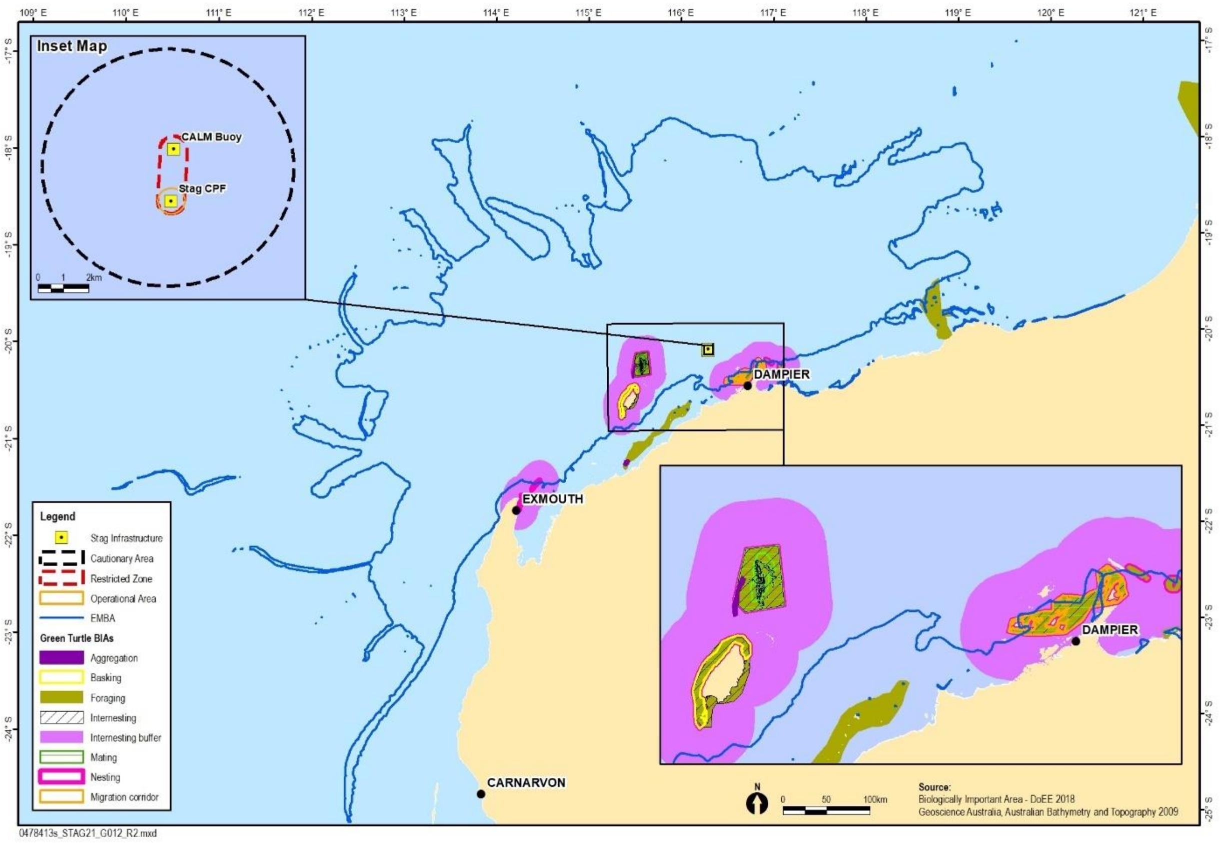

Figure 3-10: Biologically Important Areas for the Green Turtle

<u>Leatherback turtles</u>

The leatherback turtle (Dermochelys coriacea) is a pelagic feeder, found in tropical, subtropical and temperate waters, but is uncommon throughout their Australian range (DSEWPaC, 2012f). No major leatherback turtle nesting areas have been recorded in Australia, although scattered isolated nesting (1–3 nests per annum) occurs in southern Queensland and Northern Territory (Limpus and McLachlan, 1994). At least two nesting attempts have been reported in WA (Limpus, 2009b). There are no listed BIAs that overlap the EMBA or operational area.

Leatherback turtles feed mainly on pelagic, soft-bodied marine organisms such as jellyfish, which occur in greatest concentrations in areas of upwelling or convergence (DSEWPaC, 2012f). The leatherback turtle is a highly pelagic species with adults only going ashore to breed. Individuals may be encountered within the Stag Operational Area but are unlikely to be encountered in significant numbers given that no confirmed breeding occurs in WA and that leatherbacks in WA are most commonly sighted feeding in the southwest region (DSEWPaC, 2011b).

Hawksbill Turtles

WA supports one genetic stock of hawksbill turtles with nesting centred on the Dampier Archipelago. The WA stock is the largest in the Indian Ocean and is one of the largest hawksbill turtle populations remaining in the world (Limpus, 2009a). Several BIAs (foraging, internesting, internesting buffer, mating, migration corridor and nesting) have been identified that overlap the EMBA (Table 3-4 and Figure 3-11). No BIAs overlap the Operational Area

In WA, their nesting range is relatively small and extends from the Muiron Islands to the Dampier Archipelago, a distance of ~ 400 km. The most significant breeding areas are within the Dampier Archipelago, Montebello Islands, Lowendal Islands and Barrow Island supporting hundreds of nesting females annually (Pendoley, 2005; Limpus, 2009a). Rosemary Island within the Dampier Archipelago may support in the order of 1,000 nesting females annually and may be the largest remaining hawksbill nesting population globally.

Low density nesting is also known from Airlie Island, Muiron Islands and Cape Range (Limpus, 2009a). The closest known breeding/ nesting grounds to the Stag Facility are Rosemary Island (Dampier Archipelago), Montebello and Lowendal Islands.

On Varanus Island, hawksbills tend to nest in greater numbers on the eastern beaches (Pipeline Beach, Harriet Beach, and Andersons Beach). Between 1986 and 1999, approximately 350 individual hawksbills were tagged on Varanus Island (Apache, 1999). Maxwell (2003) used these data to predict that up to 260 hawksbills may visit Varanus Island each year, although a maximum number of nests at 180 per year have been recorded. The most recent turtle tagging program on Varanus Island in the 2010 breeding season reported 70 turtles coming ashore. Of these 70 turtles, 27 were hawksbills and eight were newly tagged. Pipeline Beach was the most frequented beach on Varanus Island (Pendoley Environmental, 2011).

Hawksbill turtles also nest along the North-West Cape/ Ningaloo coast, Muiron Islands, and the Montebello Islands. Rosemary Island is probably the largest hawksbill rookery, with numbers at the other sites comparable to those found on Varanus Island. This suggests a total annual hawksbill turtle stock in WA of approximately 1,000–1,500 animals. With an interbreeding period of 2–4 years, 2,000–4,500 hawksbill turtles probably nest in WA waters (Morris, 2004).

On Barrow Island, nesting occurs at low densities on the beaches of both the west and east coasts, however, Barrow Island is not considered a regionally important nesting site for hawksbill turtles (Chevron, 2008).

Although hawksbills are known to nest year-round, the Draft Turtle Recovery Plan (CoA 2016) indicates that peak nesting periods are October to February. The location of feeding areas and biology of the species within this region is largely undocumented (Limpus, 2009a) but it is thought that individuals may migrate up to 2,400 km between their nesting and foraging grounds (DSEWPaC, 2012f).

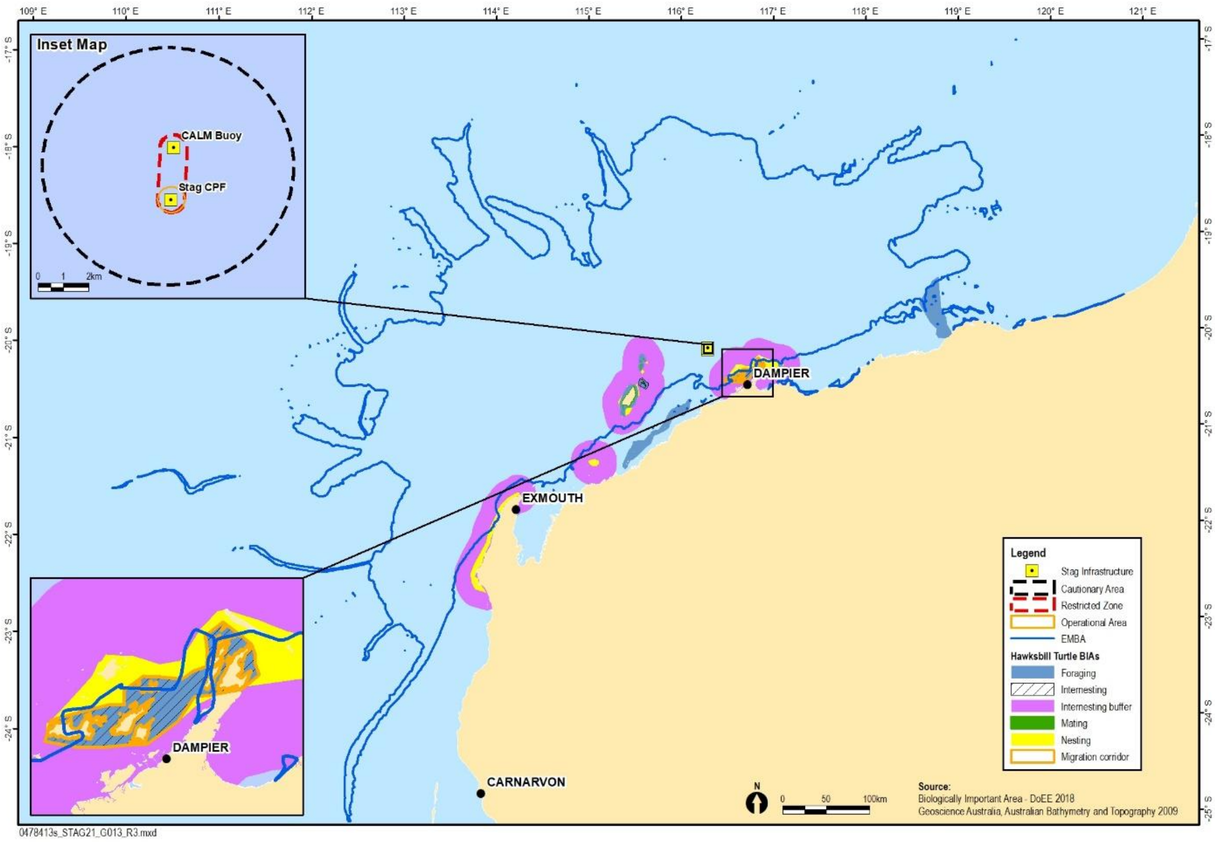

Figure 3-11: Biologically Important Areas for the Hawksbill Turtle

Flatback Turtles

The flatback turtle is endemic to the northern Australian continental shelf and all nesting occurs in Australia with approximately one third of the total breeding for the species occurring in WA. WA supports two genetic stocks of flatback turtles: the Pilbara Stock characterised by summer nesting and Southwest Kimberley stock which breeds year-round with a winter peak (Limpus 2007; CoA 2016). Several BIAs (aggregation, foraging, internesting, internesting buffer, mating, migration corridor and nesting) have been identified that overlap the EMBA (Table 3-4 and Figure 3-12). An internesting buffer BIAs overlap the Operational Area

Nesting locations for both stocks are outlined in Table 3-6. The closest known breeding/ nesting grounds to the Stag Facility are Dampier Archipelago, Barrow, Montebello, Varanus and Lowendal Islands. The Turtle Recovery Plan (CoA 2017a) has proposed a 60 km inter-nesting buffer for the flatback turtle which overlaps the Stag Operational Area.

Pendoley (2005) focussed on documenting the activity of flatback turtles on Barrow Island, Lowendal Islands and Montebello Islands and identified that the east coast of Barrow Island supports an important rookery for flatbacks. A turtle tagging program over three nesting seasons from 2005 to 2008 tagged a total of 2,979 flatbacks at Barrow Island and 1,060 flatbacks at Mundabullangana (Chevron 2008). Tagging shows that flatback turtle nesting on Barrow Island is focused on central east coast beaches, which include Mushroom, Bivalve, Terminal, and Yacht Club North and South beaches. Peak of nesting occurs during the December–January periods (Pendoley, 2005; Chevron, 2008).

Post-nesting females commonly sleep on the intertidal platform off the east coast rookery of Barrow Island at low tide. Satellite tracking of adult (female) flatback turtles shows they use a variety of inshore and offshore marine areas off the east and west coasts of Barrow Island. Females inter-nest close to their nesting beaches, typically in 0–10 m of water (Chevron, 2008). However, flatback turtles also travel approximately

70 km and inter-nest in shallow nearshore water off the adjacent mainland coast, before returning to Barrow Island to lay another clutch of eggs. The average inter-nesting period is 13–16 days. There have been occasional records of nesting by flatback turtles on the Jurabi Coast and Muiron Islands (CALM, 2005a).

From long-term tagging studies on Varanus Island and Pendoley's observations, the nesting season for flatback turtles peak in December and January with subsequent peak hatchling emergence in February and March. Flatbacks have been observed to nest on Varanus Island between November and February (Pendoley Environmental, 2011).

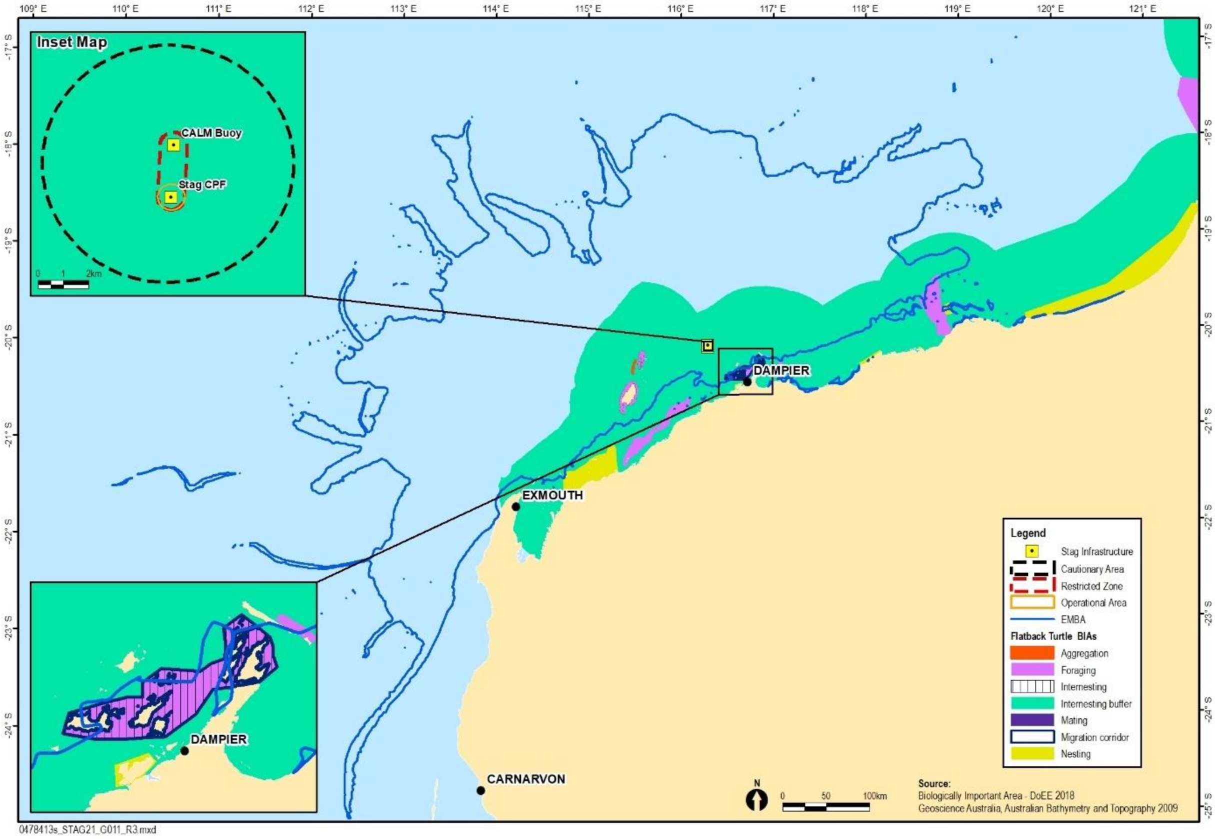

Figure 3-12: Biologically Important Areas for the Flatback Turtle

Saltwater Crocodile

The salt-water crocodile (*Crocodylus porosus*) is a migratory species under the EPBC Act and is also listed as a specially protected species (other specially protected fauna) under the BC Act. In WA, the species is found in most major river systems of the Kimberley, including the Ord, Patrick, Forrest, Durack, King, Pentecost, Prince Regent, Lawley, Mitchell, Hunter, Roe and Glenelg Rivers. The largest populations occur in the rivers draining into the Cambridge Gulf and the Prince Regent River and Roe River systems. There have also been isolated records in rivers of the Pilbara region, around Derby near Broome and as far south as Carnarvon on the mid-west coast (DEC 2009a).

Sea snakes

A search of EPBC Act protected matters revealed 18 listed seasnakes that may occur within the EMBA (Appendix B). Of these species, two are considered threatened (critically endangered), the short-nosed sea snake (*Aipysurus apraefrontalis*) and the leaf-scaled sea snake (*Aipysurus foliosquama*). There are no listed BIAs for any sea snakes.

Storr et al. (1986) estimate nine genera and 22 species of sea snakes and kraits occur in WA waters. However, little is known of the distribution of individual species, population sizes or aspects of their ecology. Sea snakes are essentially tropical in distribution, and habitats reflect influences of factors such as water depth, nature of seabed, turbidity and season (Heatwole and Cogger, 1993). Sea snakes and kraits are widespread throughout waters of the NWS in offshore and nearshore habitats. They can be highly mobile and cover large distances or they may be restricted to relatively shallow waters and some species must return to land to eat and rest.

The short-nosed sea snake is listed as critically endangered under the EPBC Act. However, most specimens have been collected from Ashmore and Hibernia Reefs (Minton and Heatwole, 1975) which are not within the EMBA. This species is believed to show strong site fidelity to shallow coral reef habitats in <10 m of water.

Table 3-6: Marine Turtle Activity

Species	Hawksbill turtle	Flatback turtle		Green turtle	Loggerhead turtle	Leatherback turtle
Stock	WA Stock	**Pilbara Stock**	**Southwest Kimberley**	NWS Stock	WA Stock	Australia
Nesting period	Year Round	October -March	Year Round	November -March	November -Mar	December -Jan
Nesting peak	Oct-Feb	Nov-Jan	Dec-Jan	Jan - Feb	January	-
Internesting buffer	20 km	60 km	60 km	20 km	20 km	-
Important rookeries	**Nesting location:** Dampier Archipelago (including Rosemary Island, Delambre Island), Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island), Lowendal Islands (including Varanus Island, Beacon Island, Bridled Island), Sholl Island	**Nesting location:** Montebello Islands, Mundabullangana Beach, Barrow Island, Thevenard Island, Cemetery Beach, Dampier Archipelago (including Delambre Island and Huay Island), coastal islands from Cape Preston to Locker Island	**Nesting location:** Eighty Mile Beach, Eco Beach, Lacepede Islands	**Nesting locations:** Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, Northwest Cape, Ningaloo coast.	**Nesting location:** South Murion Island, North-West Cape, Gnarloo Bay.	There are no Confirmed leatherback turtle nesting sites in Western Australia. Scattered nesting occurs in southern Queensland and Northern Territory such as Coburg Peninsula (outside operational area)
Generalised diet	Omnivorous, feeding on algae, sponges, soft corals and other soft-bodied invertebrates	Primarily carnivorous, feeding on soft-bodied invertebrates. Juveniles eat gastropod molluscs, squid, siphonophores. Limited data indicate that cuttlefish, hydroids, soft corals, crinoids, molluscs and jellyfish are also eaten (SPRAT, DoEE website and DoEE 2016).		Primarily herbivorous, foraging on algae, seagrass and mangroves. In their pelagic juvenile stage, they feed on algae, pelagic crustaceans and molluscs	Carnivorous, feeding predominantly on benthic invertebrates in habitats ranging from near shore to 55 m. During their post-hatchling stage, they feed on algae, pelagic crustaceans and molluscs	Oceanic and Therefore, remain planktivorous throughout their life, feeding on jellyfish and large planktonic ascidians (e.g. sea squirts) in the water column

3.6.5 Birds

Marine waters and coastal habitat in the EMBA contain habitats that are important to birds, including offshore islands, sandy beaches, tidal flats, mangroves and coastal and pelagic waters. These habitats support a variety of birds which utilise the area in different ways and at different times of the year (DSEWPaC 2012a). Birds can be broadly grouped according to their preferred foraging habitat as coastal/ terrestrial birds, seabirds and shorebirds.

Coastal or terrestrial species inhabit the offshore islands and coastal areas of the mainland throughout the year and are either primarily terrestrial or they may forage in coastal waters. Resident coastal and terrestrial species include species such as the osprey (Pandion haliaetus) (DEWHA 2008).

Shorebirds, including waders and wetland birds, inhabit the intertidal zone and adjacent areas. Some shorebird species are resident while others are migratory and include species that utilise the East Asian–Australasian Flyway. Shorebirds that regularly migrate through the area include the Scolopacidae (curlews, sandpipers etc.) and Charadriidae (plovers and lapwings) families.

Seabirds include those species whose primary habitat and food source is derived from pelagic waters and spend the majority of their lives at sea, ranging over large distances to forage over the open ocean. Seabirds present in the area include terns, petrels, shearwaters, tropicbirds, frigatebirds, boobies and albatrosses (DEWHA 2008).

A search of the EPBC protected matters database in December 2021, revealed 76 listed bird species, 18 of which are classified as threatened and may occur within the EMBA. Further information on these species is provided below. The protected matters search also identified numerous migratory marine bird species and migratory wetland bird species that may occur within the EMBA (Appendix B). Of these there have been eight birds identified that have BIAs within the EMBA (Table 3-4) Figure 3-13 shows the location of the BIAs within the EMBA and operational area.

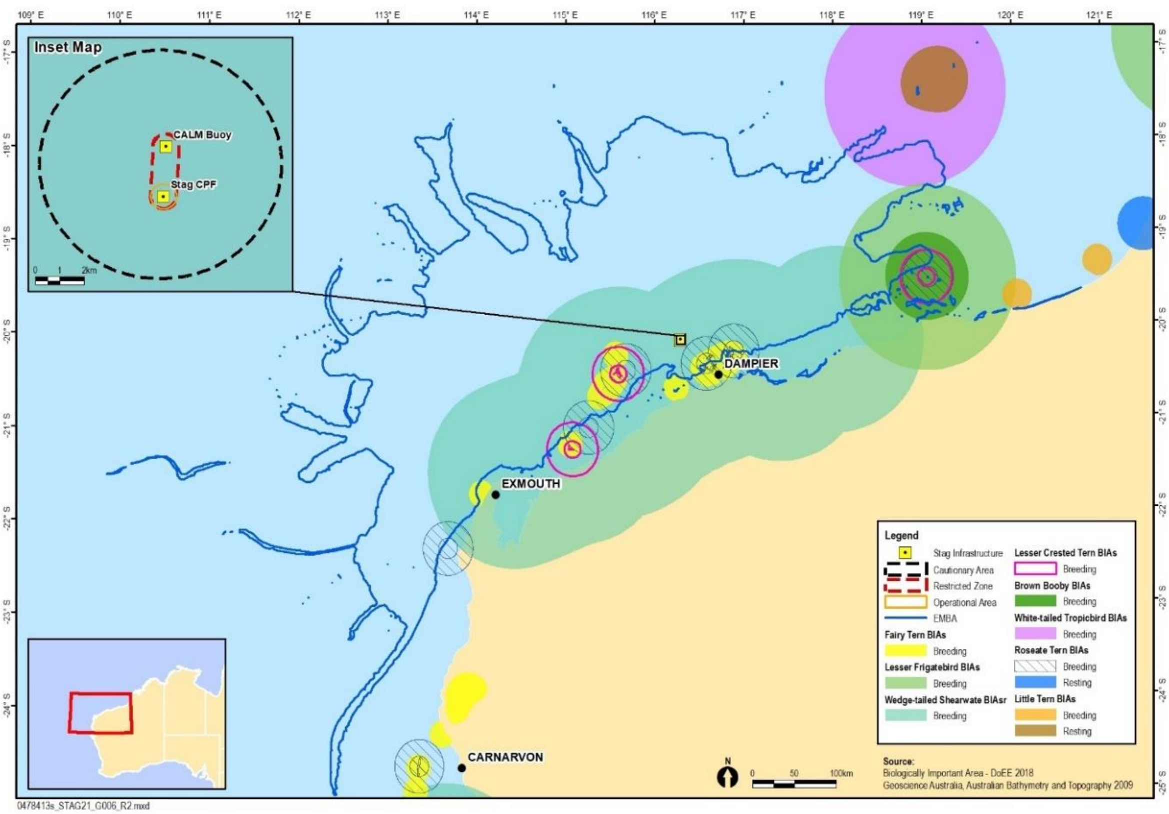

Figure 3-13: Biologically Important Areas for Seabirds within the EMBA

3.6.5.2 Shorebirds

Curlew sandpiper

This species is a migratory shorebird that breeds in north Siberia and spends the non-breeding season from western Africa to Australia (Bamford et al. 2008). The curlew sandpiper occurs around coastal Australia and preferred habitats include coastal brackish lagoons, tidal mud and sand flats, estuaries, saltmarshes and less often inland. Their diet is mainly comprised of polychaete worms, molluscs and crustaceans (Higgins & Davies 1996 in Garnet et al. 2011).

Eastern curlew

The Eastern Curlew is a migratory shorebird that breeds in Siberia, Kamchatka and Mongolia and migrates to coastal East Asia and Australia. The South Korean Yellow Sea is an important staging post for this species. Non-breeding birds occur around coastal Australia, are more common in the north and have disappeared or become much rarer at many sites along the south coast (Garnet 2011).

Non-breeding birds are present at estuaries, mangroves, saltmarshes and intertidal flats, particularly those with extensive seagrass (Zosteraceae), where they feed on marine invertebrates, especially crabs and small molluscs (Higgins & Davies 1996 in Garnet 2011).

Red knot

The red knot is a migratory shorebird and the species includes five subspecies, including two found in Australia, *Calidris canutus piersmai* and Calidris *canutus rogersi*. The red knot breeds in Siberia and spends the non-breeding season in Australia and New Zealand. Non-breeding season is spent on tidal mudflats or sandflats where they feed on intertidal invertebrates, especially shellfish (Garnet et al. 2011).

Great knot

The great knot is a migratory shorebird with a global distribution, breeding in north-east Siberia and spending the non-breeding season along coasts from Arabia to Australia. Non-breeding birds migrate to inlets, bays, harbours, estuaries and lagoons with large intertidal mud and sand flats where they feed on bivalves, gastropods, crustaceans and other invertebrates (Higgins & Davies 1996 in Garnet et al. 2011).

Greater and Lesser sand plover

The greater sand plover (Mongolian) and lesser sand plover are cogeners that breed in China, Mongolia and Russia. The greater sand plover spends the non-breeding season along coasts from Japan through southeast Asia to Australasia, while the lesser sand plover spends the non-breeding season along coasts from Taiwan to Australasia (Banford et al. 2008). Non-breeding birds occur along all Australian coasts, especially in the north for the greater sand plover (DoE 2014b) and in the east for the lesser sand plover (DoE 2014b).

Non-breeding birds forage on beaches, saltmarshes, coastal bays and estuaries, and feed on marine invertebrates including molluscs, worms, crustaceans and insects (Marchant & Higgins 1993 in Garnet et al. 2011).

Bar-tailed godwit

Two subspecies of the bar-tailed godwit exist, as determined by their breeding locations in Siberia and Alaska (Bamford et al. 2008). Non-breeding birds migrate to the coasts of Australia. The western Alaskan subspecies occurs especially on the north and east coasts of Australia whilst the northern Siberian subspecies occurs especially along the coasts of North-Western Australia (DoE 2014b).

Non-breeding birds are found on muddy coastlines, estuaries, inlets, mangrove-fringed lagoons and sheltered bays, feeding on annelids, bivalves and crustaceans (Higgins and Davies 1996 in Garnet et al. 2011).

3.6.5.3 **Seabirds**

Southern giant petrel

The southern giant petrel is listed as endangered and migratory under the EPBC Act and is a highly migratory bird which have a large natural range. This species occurs from Antarctic to subtropical waters, so while this species may over-fly the Stag Facility from time-to-time in transit or for foraging, they do not use the area for breeding (August and September) or resting as there are no critical nesting (eggs hatch between October and November) or feeding areas within the EMBA.

Australian fairy tern

Within Australia, the fairy tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia, occurring as far north as the Dampier Archipelago near Karratha. The fairy tern nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline (Higgins and Davies, 1996; Lindsey, 1986a). The bird roosts on beaches at night (Higgins and Davies, 1996). The fairy tern predates on small bait-sized fish (Van de Kam et al., 2004) by diving in shallow waters.

A breeding BIA has been identified that overlaps the EMBA Figure 3-13.

Many of the islands and rocks in the Dampier Archipelago/Cape Preston region are known breeding grounds for a variety of seabirds, including wedge-tailed shearwaters (Puffinus pacificus), caspian terns (Sterna caspia), bridled terns (Sterna anaethetus) and roseate terns (Sterna dougallii). The small islands and islets such as Goodwyn Island, Keast Island and Nelson Rocks provide important, undisturbed nesting and refuge sites (CALM, 2005b).

One-third of the 144 bird species recorded on North-West Cape are seabirds, shorebirds and waders (resident and migratory). There are approximately 33 species of seabirds found in the Ningaloo Marine Park with the main rookeries at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island. In addition, the Muiron and Sunday islands provide isolated rookeries (CALM, 2005a).

Australian Lesser Noddy

This species is usually found only around its breeding islands in the Houtman Abrolhos Islands in Western Australia (Storr et al. 1986). The Australian lesser noddy occupies coral-limestone islands that are densely fringed with white mangrove *Avicennia marina*, and it occasionally occurs on shingle or sandy beaches (Higgins & Davies 1996 in DAWE 2020a). This species is thought to be sedentary or resident, staying near to its breeding islands in the non-breeding season. It may leave nesting islands for short periods during the non-breeding season, and probably forages widely (Higgins & Davies 1996 in DAWE 2020a).

Breeding apparently occurs only on Morley, Wooded and Pelsaert Islands at the Houtman Abrolhos Islands (Higgins and Davies 1996 in DoE 2014b). Mangrove stands support approximately 68,000 breeding pairs spread over the three islands (Surman & Nicholson 2006). Breeding may also occur on Ashmore Reef (Stokes & Hinchey 1990). The breeding season extends from mid-August to early April (Higgins & Davies 1996 in DoE 2014b). The National Conservation Values Atlas does not identify any BIAs for this species in the EMBA.

Australian painted snipe

The Australian Painted Snipe is a wading bird that has been recorded at wetlands in all states of Australia (Barrett et al., 2003; Blakers et al., 1984; Hall 1910b). It is most common in eastern Australia but has been recorded less frequently in Western Australia (Barrett et al., 2003; Blakers et al., 1984; Marchant and Higgins, 1993; Rogers et al., 2005).

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (Melaleuca). The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant and Higgins 1993). Within the EMBA, the most likely habitat for this species, and therefore likelihood of occurrence, is the wetlands of Eighty Mile Beach and Roebuck Bay (Bennelongia, 2009; Hale and Butcher, 2009).

Soft-plumaged petrel

The soft-plumaged petrel is listed as vulnerable under the EPBC Act. As a mainly sub-Antarctic species they are usually seen in cooler seas but have been noted off southeast Australia between 9.8–21°C (Reid et al., 2002) and are widespread during winter and summer. As with the southern giant petrel, this species may occur foraging or flying over Operational Area waters, but there are no critical nesting or feeding areas known within the EMBA.

Abbott’s Booby

Currently, Abbott's booby is only known to breed on Christmas Island and to forage in the waters surrounding the island and south-east Asia (DoEE, 2020). Abbott's Booby is a marine species. It spends much of its time at sea but needs to come ashore to breed. It is thought that they may travel up to 400 km to feeding grounds when they are breeding (Becking 1976). Within Christmas Island, most nests are found in the tall plateau forest on the central and western areas of the island, and in the upper terrace forest of the northern coast. The National Conservation Values Atlas does not identify any BIAs for this species in the EMBA.

Christmas Island White-tailed Tropicbird

The Christmas Island white-tailed tropicbird is endemic to Christmas Island and leaves the island to forage in the warm waters of the Indian Ocean (Garnett 2011). The white-tailed tropicbird roots at sea; only incubating or brooding adults remain on nests on the island at night (Stokes 1988).

A breeding BIA has been identified that overlaps the EMBA Figure 3-13.

Albatross

A protected matters search of the waters in the area of interest identified four albatross species (Campbell, shy, black-browed and white-capped) that may occur in the area. All of the identified species predominantly occur in subantarctic to subtropical waters and breed on islands in the southern oceans (DoE 2014b).

The National Conservation Values Atlas (DAWE, 2022) and the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011c) do not identify any BIA for albatrosses within the EMBA.

Table 3-7: Seabird Biologically Important Areas that Overlap the EMBA

Species	BIA Location	Peak times
Australian Fairy Tern	Breeding: Pilbara coast incl. Dampier Archipelago and Barrow Island.	July to late September
Lesser Frigatebird	Breeding and 100 km foraging buffer: Bedout Island	March to September
White-tailed tropicbird	Breeding and foraging with 100 km buffer: Rowley Shoals	May to Oct
Wedge tailed shearwater	Foraging and breeding with 100 km buffer along Pilbara coastline and islands including: Dampier Archipelago, Passage Island, Montebello Islands, Lowendal Islands off Barrow Island and islands off Onslow	Mid Aug to April
Little tern	Breeding: Pilbara coastline along Eighty Mile Beach Resting: Rowley Shoals	June- July and Oct

Roseate tern	Breeding: Islands off Pilbara coast including Dampier Archipelago, Lowendal Is, Frazer I, Bedout Island and around Montebello Islands Resting: North Eighty Mile Beach	Mid-March to July
Brown booby	Breeding and foraging: Bedout Island	Feb to Oct, but mainly Autumn
Lesser Crested Tern	Breeding: islands off north and west Kimberley also Bedout Island, Lowendal Islands, Thevenard Island. This species is listed marine but is not identified as threatened or migratory.	March to June

Eighty Mile Beach is particularly significant for migrating shorebird species and is considered one of the most significant sites in Australia for migratory shorebirds (Hale and Butcher, 2009) as well as supporting a high diversity and abundance of wetland birds. Although many birds may then move further on their journey, many others remain at the site for the non-breeding period. Eighty Mile Beach is considered the most significant site (in terms of numbers of birds) in the South-East Asian Flyway for nine international migratory species; Bar-tailed Godwit; Terek Sandpiper, Grey-tailed Tattler, Great Knot, Red Knot, Curlew Sandpiper; Greater Sand Plover, Oriental Plover and Oriental Pratincole (Hale and Butcher, 2009). Further information on Eighty Mile Beach Ramsar Site is in Section 3.7.4.

Table 3-8: Summary of Environmental Sensitivities for Marine Fauna within the Operational Area and EMBA

Marine fauna		Operational Area	EMBA
Plankton	Plankton	Yes - Phytoplankton and zooplankton present within the operational area. Higher concentrations occurring during the winter months (June to August) during the activity and lower in summer months (December to March).	Yes - Phytoplankton and zooplankton present within the EMBA. Higher concentrations occurring during the winter months (June to August) and lower in summer months (December to March).
Invertebrates	Benthic	Yes – primarily infaunal species	Yes – will contain both mobile and sessile epifauna and infaunal
	Pelagic	Yes – includes squid, salps and jellyfish	Yes – includes squid, salps and jellyfish
Fish	Demersal and/ or pelagic fish	Yes – Both demersal and pelagic fish species present. Stag Facility infrastructure likely attracts a greater diversity and abundance of fishes than would naturally occur on the soft sediments within the Operational Area. Offshore soft sediment habitat generally supports a lower diversity than other benthic habitats that provide greater structure and feeding opportunities (e.g. rocky and coral reef, seagrass and macroalgae, mangroves)	Yes - Diverse assemblage of demersal and pelagic species distributed throughout the EMBA. Three KEFs within the EMBA likely to support high fish diversity and abundance: Glomar Shoals, Continental Slope Demersal Fish Communities and Mermaid Reef. Shallow water primary producer habitats close to mainland shorelines and offshore islands within the EMBA (e.g. seagrass, macroalgae, hard coral and mangroves) support high abundance and diversity of fishes.
	Grey nurse shark	Yes - Could occur as the Operational Area is within depth range (<200 m) but presence is unlikely since there is lack of natural structured habitat in the Operational Area. Operational area is flat bare sand.	Yes – Likely occurs as residents in some areas where habitat favorable (e.g. near inshore rocky and coral reefs between depths of 10–45 m)
	White shark	Yes - Could transit through the Operational Area although unlikely to be present for extended durations since white sharks are highly mobile species that follow seasonal feeding opportunities (e.g. whale migrations, pinniped colonies) in primarily coastal waters.	Yes – Likely to transit through and feed within the EMBA where feeding opportunities present (e.g. whale migrations, pinniped colonies) in primarily coastal waters.
	Whale shark	Yes - Could transit through the operational area, particularly around the time of aggregation at Ningaloo Reef (late March to June)	Yes - Will transit through and aggregate within the EMBA. Main period of the whale shark aggregation off Ningaloo Reef is late March to June, with the largest numbers generally recorded in April
	Sawfish	No - Given their preference for shallower estuarine and coastal waters, they are unlikely to be encountered within the Operational Area.	Yes - Could occur in estuaries and nearby coastal mangrove areas and shallow waters particularly the northern mainland coastline of the EMBA.
	Other shark/ ray species	Yes - Could transit through the operational area.	Yes - Could transit through the EMBA.

Marine mammals	Pygmy Blue whale	Yes - Northern migration in April-August and southern migration Oct - Dec. May transit through the Operational Area although migration routes believed to occur in deeper waters	Yes - EMBA overlaps migration routes in water depths of 500–1,000 m.
	Humpback whale	Yes - Peak northern migration around July. Peak southern migration around Aug/September. Greater likelihood of individuals during northern as opposed to southern migration May transit through the Operational Area as within depth range of migration routes	Yes - EMBA overlaps known migration routes and presence is reliable during migration season.
	Dugongs	No – Given their preference for shallower waters near seagrass meadows dugongs are unlikely to be encountered within the Operational Area	Yes-Dugongs occur within the EMBA associated with seagrass meadow habitat in coastal waters of the mainland or offshore islands.
	Cetacean – various whales and dolphins	Yes – A number of whale and dolphin species may transit the Operational Area. Whales are likely to be transiting during migrations while dolphins may be part of resident coastal populations.	Yes - Could occur transiting through the EMBA but not expected in large numbers as they are either infrequently recorded in Australian waters or primarily migrating through deeper waters. Dolphins may be feeding/ aggregating in shallow coastal waters of the mainland or offshore islands.
Marine Reptiles	Marine Turtles	Yes - May transit through the Operational Area although unlikely to be encountered in large numbers (with the exception of the flatback turtle, activity location is outside inter-nesting areas, ~ 35 km from nearest nesting beach at Dampier Archipelago)	Yes - For all species except Leatherback turtle nesting beaches and breeding/feeding areas occur within the EMBA either on the mainland coastline or offshore islands
	Sea snakes and kraits	No – Not likely to be encountered given the water depth and distance from shore	Yes - May be encountered in shallow waters habitats of EMBA where feeding habitat is found.
Avifauna	Wetland/ Shorebirds	No – Given the distance offshore, shorebirds or wetland birds are unlikely to be present within the Operational Area	Yes – May occur within the EMBA along shorelines and wetlands feeding or nesting. Areas of particular importance are the Ramsar wetland sites at Eighty- mile Beach. Shorebirds also use Montebello/ Lowendal/Barrow Islands.
	Seabirds	Yes – May utilise the waters of the Operational Area for feeding and may be attracted to the Stag Facility by increased abundance of pelagic fish or as resting habitat.	Yes – May occur within the EMBA, either feeding, migrating or utilising coastal islands or mainland shores as nesting habitat.

3.7 Protected Areas

A search of the EPBC Act Protected Matters Database in December 2021 listed a number of areas that are considered matters of National Environmental Significance (NES) as well as other matters protected under the Act. Those with marine elements or potentially contacted in the event of a crude spill are outlined in Table 3-9 and discussed in more detail in the following section; terrestrial protected areas or elements that are already included within existing protected areas (such as within a marine park) are not singled out. Section 3.8 addresses other sensitivities such as State Reserves.

Table 3-9: Summary of Protected Areas (marine) within the EMBA

Area type	Title
World Heritage Area	The Ningaloo Coast
National Heritage Properties	The Ningaloo Coast
	Dampier Archipelago (including Burrup Peninsula)
Commonwealth Heritage Place	Mermaid Reef - Rowley Shoals
	Ningaloo Marine Area - Commonwealth Waters
Wetland of International Importance (Ramsar)	Eighty Mile Beach
Wetlands of National Significance	Eighty Mile Beach System
	Mermaid Reef
Australian Marine Parks (AMP)	Argo-Rowley Terrace AMP
	Dampier AMP
	Eighty Mile Beach AMP
	Gascoyne AMP
	Mermaid Reef AMP
	Montebello AMP
	Ningaloo AMP
Key Ecological Features (KEF)	Ancient coastline at 125 m depth contour
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula
	Commonwealth Waters adjacent to Ningaloo Reef
	Continental Slope Demersal Fish Communities
	Exmouth Plateau
	Glomar Shoals
	Mermaid Reef and Commonwealth Waters
Threatened Ecological Communities	None Identified
State Marine Reserves	Barrow Island Marine Park
	Barrow Island Marine Management Area
	Eighty Mile Beach Marine Park
	Montebello Islands Marine Park
	Muiron Island Marine Management Area
	Ningaloo Marine Park
	Rowley Shoals Marine Park

3.7.1 World Heritage Properties

One World Heritage Property, The Ningaloo Coast, overlaps the EMBA. The Ningaloo Coast was granted World Heritage Status in June 2011. The World Heritage Area (WHA) encompasses an area of 7,050 km^2, including State and Commonwealth waters, extending 25 km offshore. The WHA is primarily comprised of the Ningaloo Marine Park (State waters and the adjoining Commonwealth waters section). Also included are the Muiron Islands MMA and Nature Reserve, the Bundegi and Jurabi coastal parks and the Cape Range National Park, plus crown, leasehold and freehold land. The Area is managed under the Ningaloo Coast Strategic Management Framework agreed by State and Commonwealth governments. Both state and commonwealth marine parks and reserves are managed on a day to day basis by the Department of Biodiversity, Conservation and Attractions (DBCA) on behalf of the respective authorities.

The Marine Parks and Reserves protect most of the Ningaloo Reefs, which stretch 290 km from North-West Cape south to Red Bluff comprising the 200 km long Ningaloo Barrier Reef enclosing a lagoon that varies in width from 200 m to 7 km, and extensive fringing reefs to the north and south of the barrier (Commonwealth of Australia 2010). Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (CALM 2005a). The Ningaloo Coast WHA forms the backbone of the nature-based tourism industry in the Exmouth region.

Key features that supported the WHA listing of the Ningaloo Coast (UNESCO 2013; Commonwealth of Australia 2010) include:

- Landscapes and seascapes of the property are comprised of mostly intact and large-scale marine, coastal and terrestrial environments;
- Over 300 species of coral;
- Over 650 species of mollusc (clams, oysters, octopus, cuttlefish, snails);
- More than 1,000 species of fish including over 700 species of reef fish;
- 600 species of crustacean;
- 155 species of sponges;
- A high diversity of echinoderms (sea stars, sea urchins, sea cucumbers) including 25 new species; and
- Habitat for iconic species, including whales, dugong, whale sharks and turtles.

The Parks and Reserves included in the WHA are also important habitat for migratory seabirds and waders, including migratory wading birds listed in the CAMBA and JAMBA agreements (CALM 2005a).

3.7.2 National Heritage Properties

There are two National Heritage Properties that overlap with the EMBA:

- Ningaloo Coast (see Section 3.7.1); and
- Damper Archipelago (including Burrup Peninsula)

<u>Dampier Archipelago</u>

Dampier Archipelago was included on the National Heritage List in July 2007. Approximately 36,860 ha at Dampier were listed; comprising parts of the Burrup Peninsula and surrounding islands (Figure 3-14). Reefs, shoals and islands of the Dampier Archipelago provide important habitat for many native plant and animals. The Burrup Peninsula has been nominated for UNESCO World Heritage listing (in June 2018) and includes Aboriginal rock art where engravings provide an outstanding visual record of Australia’s history. The area contains one of the densest concentrations of rock engravings in Australia with some sites containing thousands or tens of thousands of images. There is a high density of stone arrangements on the Burrup

Peninsula including standing stones, stone pits and more complex circular stone arrangements (Commonwealth of Australia, 2007).

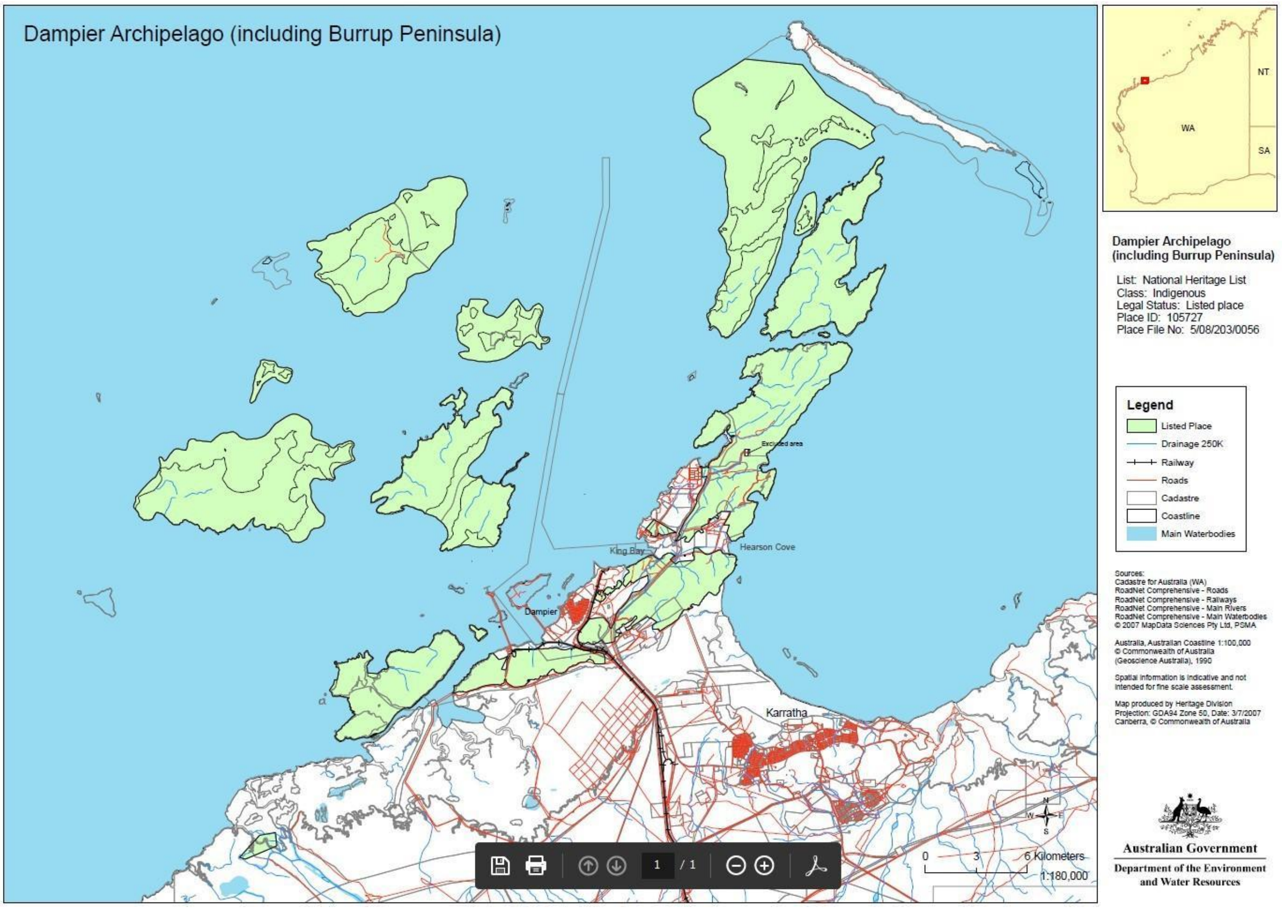

Figure 3-14: National Heritage Features of the Dampier Archipelago

3.7.3 Commonwealth Heritage Places

Two Commonwealth Natural Heritage Places were identified from the EPBC Act protected matters search of the EMBA area:

- Mermaid Reef – Rowley Shoals; and
- Ningaloo Marine Area – Commonwealth Waters.

Ningaloo Reef Area has been described in Section 3.7.1('The Ningaloo Coast') and Mermaid Reef has been described in Section 3.7.6.6 ('Mermaid Reef AMP).

3.7.4 Ramsar Wetland Sites

A 'declared Ramsar wetland' is a wetland area of international importance that has been designated under Article 2 of the Ramsar Convention or declared by the Minister to be a declared Ramsar wetland under Section 16 of the EPBC Act. There is one declared Ramsar site within the EMBA: Eighty- mile Beach. Roebuck Bay Ramsar site is not overlapped by the EMBA and will not be affected by an unplanned hydrocarbon spill, and so is not discussed further.

<u>Eighty Mile Beach</u>

The Eighty Mile Beach Ramsar site comprises a 220km beach between Port Hedland and Broome with extensive intertidal mudflats and Mandora Salt Marsh, located 40 km east (Hale and Butcher 2009) totalling 175,487 ha. Eighty Mile Beach is characterised by extensive mudflats supporting an abundance of macroinvertebrates which provide food for large numbers of shorebirds.

Eighty Mile Beach is one of the most important sites for migratory shorebirds in the East Asian Australasian Flyway, with 42 migratory shorebird species recorded at this location. It is estimated that 500,000 shorebirds use Eighty Mile Beach as a migration terminus annually (Hale and Butcher 2009), and more than 472,000 migratory waders have been counted on the mudflats during the September to November period. The location of Eighty Mile Beach makes it a primary staging area for many migratory shorebirds on their way to and from Alaska and eastern Siberia (Hale & Butcher 2009). Although many birds move further on their journey, others remain at the site for the non-breeding period.

Eighty-mile Beach supports more than one per cent of the flyway population (or one per cent of the Australian population for resident species) of 21 waterbirds, including 17 migratory species and four Australian residents. It is one of the most important sites in the world for the migration of Great Knot.

Eighty Mile Beach also supports a high diversity and abundance of wetland birds. A total of 97 wetland bird species have been recorded within the beach portion of the Ramsar site (Hale & Butcher 2009). This includes 42 species that are listed under international migratory agreements CAMBA (38), JAMBA (38) and ROKAMBA (32) as well as an additional 22 Australian species that are listed under the EPBC Act. In addition, there is a single record for Nordmann’s Greenshank (*Tringa guttifer*) from the beach, which is listed as endangered under the IUCN Red List.

The Mandora Salt Marsh area contains an important and rare group of wetlands (Lake Walyarta and East Lake), including raised peat bogs, a series of small permanent mound springs and the most inland occurrence of mangroves in WA (Hale and Butcher 2009). A small number of tidal creeks dissect the beach, including Salt Creek which is fed partly from groundwater and has permanent surface water. The Mandora Salt Marsh lakes fill predominantly from rainfall and runoff in the wet season then dry back to clay beds. The mound springs likely come from water deep within the Broome sandstone aquifer rising through fractures in the rock and resulting in permanent mostly freshwater surface water. Flatback turtles (*Natator depressus*), listed as vulnerable under the EPBC Act, regularly nest at scattered locations along Eighty Mile Beach.

Eighty Mile Beach is used for beach-based recreation, including four-wheel driving, motorcycling, fishing and shell collecting. Mandora Salt Marsh is mainly used for cattle grazing. The site is traditionally part of Karajarri Country in the north, Nyangumarta Country in the south and Ngarla Country in the southern end of Eighty Mile Beach. The site has artefacts such as middens, pinka (large baler shells used to scoop and carry water for drinking), wilura (used for sharpening spear heads), axes, and flakes, and kurtanyanu and jungari (grinding stones).

3.7.5 Nationally Important Wetlands

The PMST search highlighted two (2) Nationally Important Wetlands within the EMBA:

- Eighty Mile Beach System; and
- Mermaid Reef.

<u>Eighty Mile Beach System</u>

The site comprises Eighty Mile Beach between Cape Missiessy and Cape Keraudren and adjoining tidal mudflats; also, coastal plain with distinct swamps, immediately inland of the beach, mainly near Anna Plains Homestead. Eighty Mile Beach is a megascale (220 km) linear sand-coast; the beach is 100 m wide and includes several muddy, microscale irregular embayments. Adjoining tidal mudflats are 0.5-1 km wide.

The site is one of the most important migration stop-over areas for shorebirds in East Asia–Australasia, supporting more than 300,000 birds. Open-shrubland (mangrove) at the small embayments in periform arrangement; open-tussock grassland in latiform arrangement on the coastal plain, and open-scrub in periform arrangement at the swamps. An outstanding example of a major beach with associated inter-tidal flats and coastal floodplain, located in the arid tropics.

More information on Eighty Mile Beach is presented above in Section 3.7.4.

Mermaid Reef

See Section 3.7.6.6 for relevant information.

3.7.6 Australian Marine Parks

Seven Australian Marine Parks (AMPs) overlap the EMBA (Figure 3-15) as outlined in Table 3-10.

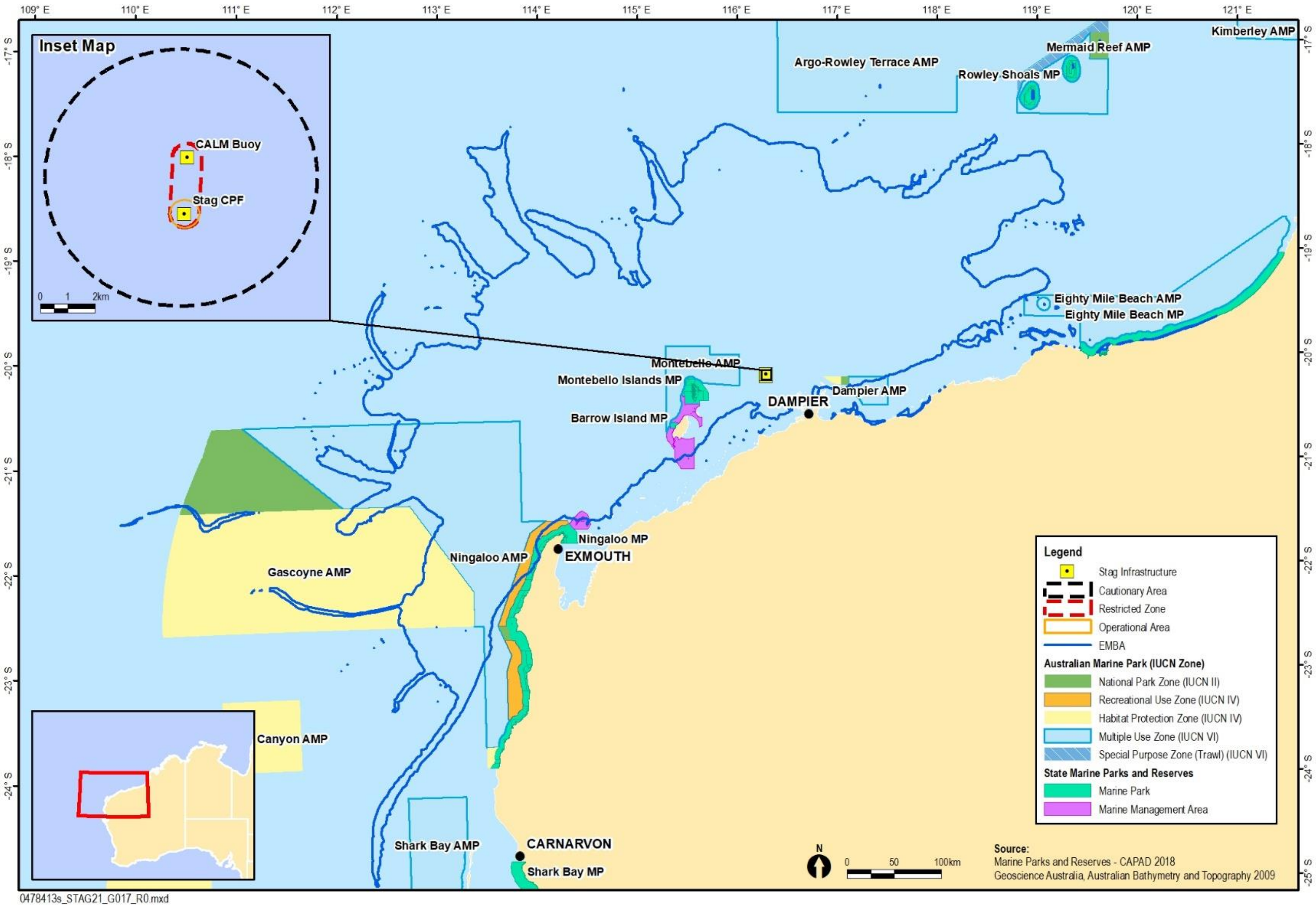

Figure 3-15: State Marine Reserves and Australian Marine Parks

Table 3-10: Australian Marine Parks within the EMBA

Australian Marine Parks	Distance from Stag Facility	IUCN Categories overlapped
Argo-Rowley Terrace AMP	290 km	Marine National Park Zone (IUCN II) Multiple Use Zone (IUCN VI)
Dampier AMP	60 km	Habitat Protection Zone (IUCN IV) Special Purpose Zone (ports) - IUCN Category VI Marine National Park Zone - IUCN Category II
Eighty Mile Beach AMP	280 km	Multiple Use Zone (IUCN VI)
Gascoyne AMP	270 km	Multiple Use Zone (IUCN VI) Marine National Park Zone (IUCN II) Habitat Protection Zone (IUCN IV)
Mermaid Reef AMP	80 km	Marine National Park Zone (IUCN II)
Montebello AMP	30 km	Multiple Use Zone - IUCN Category VI
Ningaloo AMP	260 km	Recreational Use Zone (IUCN IV)

The following descriptions of the major conservation values for each AMP are taken from the Department of the Environment and Energy website.

3.7.6.2 IUCN Principles

Existing and proposed AMPs are subject to the Australian IUCN reserve management principles as presented in Schedule 8 of the EPBC Regulations. Until management plans come into effect for any new proposed AMP in the NWMR, transitional arrangements apply, and there are no changes on the water for users of the new proposed reserves (DoE 2014c)).

3.7.6.3 Argo-Rowley Terrace Marine Park

Based on modelling of the worst-case spill scenario, the EMBA overlaps the Argo Rowley Terrace Marine Park Multiple Use Zone IUCN VI but does not overlap the Marine National Park Zone IUCN II, which is ~50 km from its boundary. The AMP has the following major conservation values:

- Important foraging areas for migratory seabirds and the endangered loggerhead turtle;
- Important area for sharks, which are found in abundance around the Rowley Shoals relative to other areas in the region;
- The park provides protection for the communities and habitats of the deeper offshore waters of the region in depth ranges from 220 m to over 5,000 m;
- The park provides protection for many seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope;
- Examples of the communities and seafloor habitats of the Northwest Transition and Timor Province provincial bioregions;
- The park provides connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the Western Australian Rowley Shoals Marine Park and the deeper waters of the region;
- Two key ecological features (KEFs) are included in the reserve:

- The canyons linking the Argo Abyssal Plain with the Scott Plateau (unique seafloor feature with enhanced productivity and feeding aggregations of species); and
- Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals (an area of high biodiversity with enhanced productivity and feeding and breeding aggregations).

3.7.6.3 Dampier Marine Park

The Dampier Marine Park (Marine National Park IUCN II and Habitat Protection Zone IV) is located ~60 km east of the Stag Facility and overlaps the EMBA. The AMP has the following major conservation values:

- Foraging areas adjacent to important breeding areas for migratory seabirds;
- Foraging areas adjacent to important nesting sites for marine turtles;
- Includes part of the migratory pathway of the humpback whale;
- The park provides a high level of protection for offshore shelf habitats adjacent to the Dampier Archipelago;
- The park provides high level protection for the shallow shelf with depths ranging from 15 m to 70 m; and
- Examples of the communities and seafloor habitats of the Northwest Shelf Province provincial bioregion as well as the Pilbara (nearshore) and Pilbara (offshore) meso-scale bioregions.

3.7.6.4 Eighty Mile Beach Marine Park

The Eighty Mile Beach Marine Park (Multiple Use Zone IUCN VI) overlaps the EMBA and is located 280 km east of the Stag Facility. The AMP has the following major conservation values:

- Foraging areas adjacent to important breeding areas for migratory seabirds;
- Foraging areas adjacent to important nesting sites for marine turtles;
- Includes part of the migratory pathway of the protected humpback whale;
- Adjacent to important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish;
- The park provides protection for the shelf, including terrace and banks and shoal habitats, with depths ranging from 15 m to 70 m; and
- Examples of the communities and seafloor habitats of the Northwest Shelf Province provincial bioregion and the Canning, Northwest Shelf, Pilbara (nearshore), Pilbara (offshore) and Eighty Mile Beach meso- scale bioregions.

3.7.6.5 Gascoyne Marine Park

The EMBA overlaps all IUCN categories of the Gascoyne AMP which ranges in depth from ~15 m to 6,000 m. The Gascoyne AMP has the following major conservation values:

- Important foraging areas for:
  - Migratory seabirds,
  - The threatened and migratory hawksbills and flatback turtles,
  - The vulnerable and migratory whale shark.
- The park provides a continuous connectivity corridor from shallow depths around 15 metres out to deep offshore waters on the abyssal plain at over 5,000 m in depth;

- The park provides protection to many seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise. It also provides protection for sponge gardens in the south of the reserve adjacent to Western Australian coastal waters;
- Examples of the ecosystems of the Central Western Shelf Transition, the Central Western Transition and the Northwest province provincial bioregions as well as the Ningaloo meso-scale bioregion;
- Three key ecological features for the region:
  - Canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula (enhanced productivity, aggregations of marine life and unique sea-floor feature.
  - Exmouth Plateau (unique sea-floor feature associated with internal wave generation),
  - Continental slope demersal fish communities (high species diversity and endemism - the most diverse slope bioregion in Australia with over 500 species found with over 64 of those species occurring nowhere else)
- The canyons are believed to be associated with the movement of nutrients from deep water over the Cuvier Abyssal Plain onto the slope where mixing with overlying water layers occurs at the canyon heads. These canyon heads, including that of Cloates Canyon, are sites of species aggregation and are thought to play a significant role in maintaining the ecosystems and biodiversity associated with the adjacent Ningaloo Reef; and
- The park therefore provides connectivity between the inshore waters of the existing Ningaloo Marine Park and the deeper waters of the area

3.7.6.6 Mermaid Reef Marine Park

The Mermaid Reef Marine Park (IUCN Category Ia - Strict Nature Reserve) overlaps the EMBA and is located 480 km northeast of the Stag Facility. The reserve has the following major conservation values:

- Mermaid Reef has national and international significance due to its pristine character, coral formations, geomorphic features and diverse marine life;
- Key area for over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition;
- Important areas for sharks including the grey reef shark, the whitetip reef shark and the silvertip whaler;
- Important foraging area for marine turtles;
- Important area for toothed whales, dolphins, tuna and billfish;
- Important resting and feeding sites for migratory seabirds;
- The park, along with nearby Rowley Shoals Marine Park, provides the best geological example of shelf atolls in Australia; and
- Examples of the seafloor habitats and communities of the Northwest Transition

3.7.6.7 Montebello Marine Park

The Montebello Marine Park (Multiple Use Zone, IUCN Category VI) overlaps the EMBA and is located approximately 30 km west of the Stag Facility. The park has the following conservation values:

- Foraging areas adjacent to important breeding areas for migratory seabirds;
- Foraging areas for vulnerable and migratory whale sharks;

- Foraging areas adjacent to important nesting sites for marine turtles;
- Part of the migratory pathway of the humpback whale;
- Shallow shelf environments with depths ranging from 15 m to 150 m, including shelf and slope habitats, as well as pinnacle and terrace seafloor features;
- Examples of the seafloor habitats and communities of the Northwest Shelf Province, as well as the Pilbara (offshore) meso-scale bioregion; and
- One key ecological feature for the region being the Ancient Coastline (a unique seafloor feature that provides areas of enhanced biological productivity).

3.7.6.8 Ningaloo Marine Park

The EMBA overlaps the Ningaloo Marine Park (recreational use zone) located ~260 km southwest of the Stag Facility. Together with the Ningaloo Marine Park and Muiron Islands Management Area, both in State waters, the Ningaloo Marine Park forms the Ningaloo Coast World Heritage Area. The Ningaloo Marine Park has the following conservation values:

- Foraging areas for vulnerable and migratory whale sharks;
- Foraging areas and adjacent to important nesting sites for marine turtles;
- Includes part of the migratory pathway of the protected humpback whale;
- The park includes shallow shelf environments and provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features; and
- Examples of the seafloor habitats and communities of the Central Western Shelf Transition.

3.7.6.9 Key Ecological Features

Seven marine key ecological features (KEFs) of the NWMR overlap the EMBA (refer Figure 3-16). These KEFs are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity. Table 3-11 lists the KEFs together with their distance from the Stag Facility. Details on these KEFs are provided below.

Table 3-11: Distances from Stag Facility to Key Ecological Features within the EMBA

Key ecological feature (KEF)	Distance from Stag Facility
Ancient coastline at 125 m depth contour	~70 km
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	~215 km
Commonwealth Waters adjacent to Ningaloo Reef	~260 km
Continental Slope Demersal Fish Communities	~110 km
Exmouth Plateau	~210 km
Glomar Shoals	~70 km
Mermaid Reef and Commonwealth Waters	~390 km

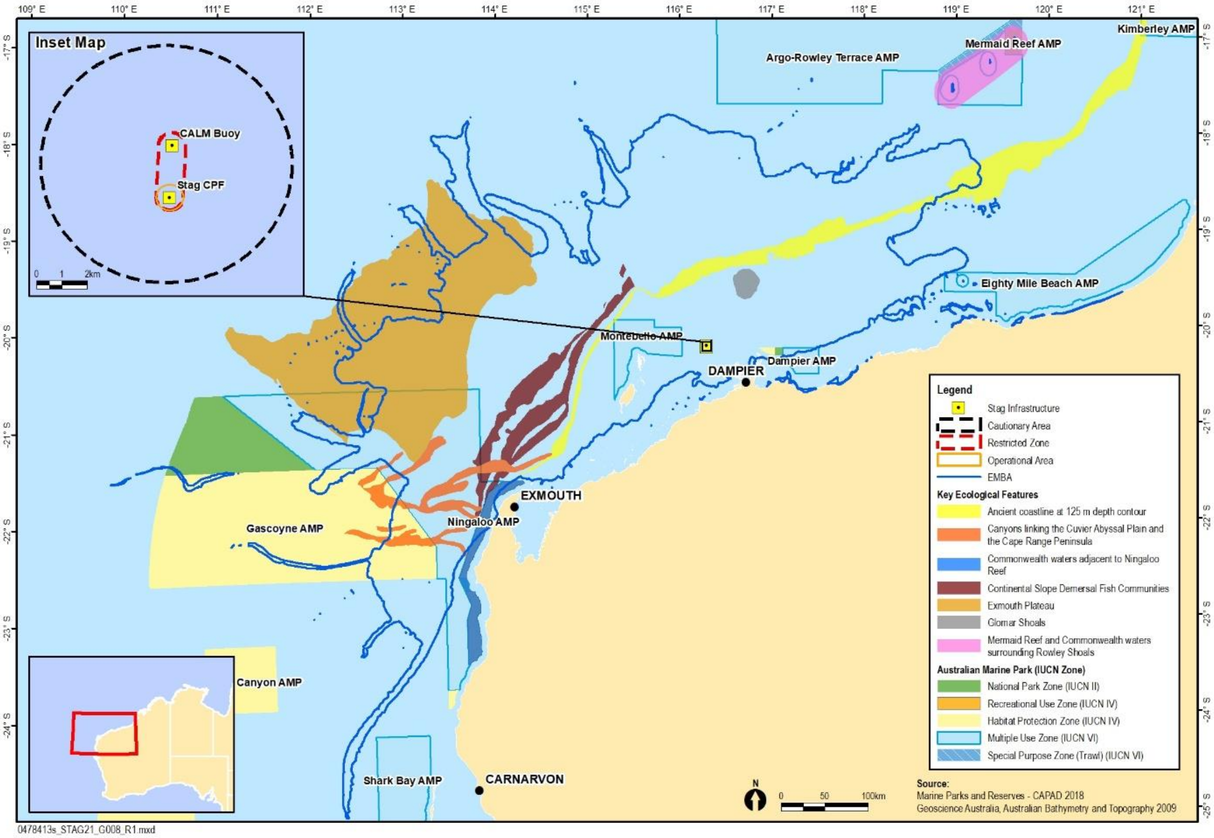

Figure 3-16: Key Ecological Features

Ancient coastline at 125 m depth contour

The shelf of the NWMR contains several terraces and steps, which reflect the gradual increase in sea level across the shelf that occurred during the Holocene. The most prominent of these occurs episodically as an escarpment through the Northwest Shelf Province and Northwest Shelf Transition, at a depth of approximately 125 m. Where the ancient submerged coastline provides areas of hard substrate it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat.

The escarpment may facilitate increased availability of nutrients in particular locations off the Pilbara coast by disrupting internal waves thereby facilitating enhanced vertical mixing of water layers. Enhanced productivity may attract opportunistic feeding by larger marine life including humpback whales, whale sharks and large pelagic fish.

Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula

The canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula include the Cape Range Canyon and the Cloates Canyon. They are believed to be associated with upwelling as they channel deep water from the Argo Abyssal Plain up onto the slope, where it mixes with the overlying water layers at the canyon heads. The upwelling zones at the canyon heads are sites of species aggregations such as sweetlip emperor fish. The soft bottom habitats within the canyons themselves are likely to support important assemblages of epibenthic species. The canyons are thought to be significant contributors to the biodiversity of the adjacent Ningaloo Reef, as they channel deep water nutrients up to the reef, stimulating primary productivity.

Commonwealth waters adjacent to Ningaloo Reef

Ningaloo Reef is globally significant as the only extensive coral reef in the world that fringes the west coast of a continent and as a seasonal aggregation site for whale sharks. The Australian Commonwealth waters adjacent to Ningaloo Reef and associated canyons and plateau are interconnected and support the high productivity and species richness of Ningaloo Reef.

Refer Ningaloo AMP (Section 3.7.6.8) for further details on the values and sensitivities of the KEF.

Continental Slope Demersal Fish Communities

Demersal slope fish assemblages in the Timor Province, the Northwest Transition and the Northwest Province are characterised by high endemism and species diversity. The level of endemism of demersal fish species in these bioregions is high compared to anywhere else along the Australian continental slope. The Northwest Province, specifically the continental slope between North-West Cape and the Montebello Trough, has more than 500 fish species, 76 of which are endemic, making it the most diverse slope bioregion in Australia. The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fish, of which 64 are considered to be endemic, and is the second richest area for demersal fish species across the entire Australian continental slope.

Exmouth Plateau

The Exmouth Plateau covers an area of approximately 50,000 km^2 and consists of a generally rough and undulating surface at water depths of approximately 500 m to more than 5,000 m. The plateau is thought to be dotted with numerous pinnacles. It is an important geomorphic feature that modifies the flow of deep waters and has been identified as a site where internal waves are generated by internal tides. The plateau also receives settling detritus and other matter from the pelagic environment.

Glomar Shoals

The Glomar Shoals are regionally important for their high biological diversity and high localised productivity. The Glomar Shoals are in water depths of 26–70 m and are distinguished by highly fractured molluscan debris, coralline rubble and coarse carbonate sand (Baker et al., 2008). They are an important seafloor feature in Commonwealth waters as they are a raised feature on a relatively featureless continental shelf. They are characterised as a high-energy environment because of current action, thereby resulting in local enhancements in productivity (DSEWPaC, 2012c). Enhanced biological productivity supports significant populations of a number of commercially important fish species such as Rankin cod, brownstripe snapper, red emperor, crimson snapper and frypan bream.

Mermaid Reef and Commonwealth Waters

This key ecological feature is recognised because of its biodiversity (aggregations of marine life) and ecological functioning and integrity (high productivity) values, which apply to both the benthic and pelagic habitats within the feature.

The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located about 300 km northwest of Broome. This KEF encompasses Mermaid Reef AMP as well as waters from 3 nautical miles out to 6 nautical miles surrounding Clerke and Imperieuse reefs. Further information on the values and sensitivities of the Rowley Shoals are provided in Section 3.7.6.3.

The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the northwest. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al., 1994).

3.7.7 Summary of Values and Sensitivities for EPBC Act Protected Matters within the Operational Area and EMBA

Table 3-12 summarises the habitats that may be affected by routine events at the Stag Facility within the Operational Area as well as accidental events that may arise within a larger EMBA.

Table 3-12: Summary of Environmental Values and Sensitivities

Protected matter	Environmental value	Sensitivities overlapped	
		Operational Area	**EMBA**
World Heritage Areas			
The Ningaloo Coast	Extensive fringing reef and lagoonal system. Supports high diversity of corals, molluscs, fish, crustaceans and sponges. Important habitat for protected and iconic turtles (foraging and nesting), whales (migrating and resting) and whale sharks (feeding aggregations).	**No**	**Yes –** oil could potentially reach and coat shoreline habitats and coastal waters at this site.
National Heritage Properties			
The Ningaloo Coast	See WHA	**No**	**Yes**
Dampier Archipelago (including Burrup Peninsula)	Important site for indigenous rock painting and stone arrangements.	**No**	**No –** sites above high water mark and would not be impacted from any oil spill scenarios.
Commonwealth Heritage Place			
Mermaid Reef - Rowley Shoals	See Mermaid Reef AMP	**No**	**Yes**
Ningaloo Marine Area - Commonwealth Waters	See Ningaloo Coast WHA and AMP	**No**	**Yes**

Protected matter	Environmental value	Sensitivities overlapped	
		Operational Area	EMBA
Ramsar sites			
Eighty Mile Beach	This site comprises beach, extensive mudflats and wetlands for feeding/roosting of shorebird/wetland bird species and is an internationally important site for migratory shorebirds.	**No**	**Yes –** oil could potentially reach and coat shorelines and mudflats of this site.
Wetlands of National Significance			
Eighty Mile Beach System	See Ramsar Sites	**No**	**Yes**
Mermaid Reef	See Mermaid Reef AMP	**No**	**Yes**
Commonwealth Marine Parks			
Argo-Rowley Terrace AMP	Important foraging areas for migratory seabirds and the endangered loggerhead turtle. Important area for sharks. The reserve provides protection for many seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope and provides connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the WA Rowley Shoals Marine Park and the deeper waters of the region.	**No**	**Yes –** sensitivity is for species (e.g. whales, turtles, seabirds and whale sharks) that use Surface waters within the reserve and therefore susceptible to oiling.
Dampier AMP	Contains foraging areas adjacent to important breeding/nesting areas for migratory seabirds and turtles and foraging areas for migratory whale sharks. Part of the migratory pathway of the humpback whale.	**No**	**Yes –** sensitivity is for species (e.g. whales, turtles and whale sharks) that use surface waters within the reserve and therefore susceptible to oiling.
Eighty Mile Beach AMP	Contains foraging areas adjacent to Important breeding/nesting areas for migratory seabirds and turtles and foraging areas for migratory whale sharks. Part of the migratory pathway of the humpback whale. Adjacent to important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish.	**No**	**Yes – s**ensitivity is for species (e.g. whales, turtles and whale sharks) that use surface waters within the reserve and therefore susceptible to oiling.
Gascoyne AMP	Contains important foraging areas for seabirds, hawksbill and flatback turtles and whale sharks. Includes seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise and provides protection for sponge gardens in southwest of the reserve.	**No**	**Yes –** sensitivity is only for species (hawksbill and flatback turtles and whale sharks) that use surface waters within the reserve and therefore susceptible to oiling.

Protected matter	Environmental value	Sensitivities overlapped	
		Operational Area	**EMBA**
Mermaid Reef AMP	Mermaid Reef has national and international significance due to its pristine character, coral formations, geomorphic features and diverse marine life (e.g. hard coral). Important areas for sharks, toothed whales, dolphins, tuna and billfish. Important foraging habitat for turtles and important resting and feeding sites for migratory seabirds. One of the best geological example of shelf atolls in Australia.	**No**	**Yes** – sensitivity is for species (e.g. whales, turtles, seabirds and whale sharks) that use Surface waters within the Reserve and therefore susceptible to oiling.
Montebello AMP	Contains foraging areas adjacent to important breeding/nesting areas for migratory seabirds and turtles and foraging areas for migratory whale sharks. Part of the migratory pathway of the humpback whale.	**No**	**Yes** – sensitivity is for species (e.g. whales, turtles and whale sharks) that use surface waters within the reserve and therefore susceptible to oiling.
Ningaloo AMP	Values in Commonwealth waters are around feeding, migrating and aggregating areas for turtles, whales and whale sharks as well as diverse subtidal benthic habitats.	**No**	**Yes** – sensitivity is for species (e.g. whales, turtles and whale sharks) that use surface waters within the reserve and therefore susceptible to oiling.
Key Ecological Features			
Ancient coastline at 125 m depth contour	Where the ancient submerged coastline provides areas of hard substrate it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat. May facilitate increased availability of nutrients in particular locations off the Pilbara coast. This enhanced productivity may attract opportunistic feeding by larger marine life including humpback whales, whale sharks and large pelagic fish.	**No.**	**Yes** – sensitivity is for species (e.g. whales, turtles, seabirds and whale sharks) that may be in high abundance above feature and therefore susceptible to oiling.
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	Believed to be associated with upwelling. The upwelling zones at the canyon heads are sites of species aggregations such as sweetlip emperor fish. The soft bottom habitats within the canyons themselves are likely to support important assemblages of epibenthic species.	**No.**	**Yes** –Oil interacting with increased species in upwelled surface waters (e.g. plankton, fish, whale sharks).
Commonwealth waters adjacent to Ningaloo Reef	Sensitivities as for Ningaloo AMP	**No.**	**Yes** – As per Ningaloo Marine Reserve
Continental Slope Demersal Fish Communities	High endemism and diversity of demersal fish species	**No**	**Yes** – oil will not directly impact demersal fish species although may interact with demersal fish larvae and eggs over a larger area.

Protected matter	Environmental value	Sensitivities overlapped	
		Operational Area	EMBA
Exmouth Plateau	Plateau is thought to be dotted with numerous pinnacles. It is an important geomorphic feature that modifies the flow of deep waters.	**No**	**No –** oil will not directly impact this feature or increased benthic diversity associated with this feature.
Glomar Shoals	Regionally important for their high biological diversity and high localised productivity. Enhanced biological productivity supports significant populations of a number of commercially important fish species such as Rankin cod, brownstripe snapper, red emperor, crimson snapper and frypan bream.	**No**	**Yes –** oil could interact with increased productivity within surface waters (e.g. plankton, fish, whale sharks)
Mermaid Reef and Commonwealth Waters	Sensitivity as for Mermaid Reef AMP	**No**	**Yes-** as for Mermaid Reef AMP

3.8 State Marine Reserves

Seven State marine reserves have been identified within the EMBA as outlined in Figure 3-15 and Table 3-13**.**

Table 3-13: Distances from Stag Facility to State Marine Reserves within the EMBA

State Marine Reserve	Distance from Stag Facility
Barrow Island Marine Park	~110 km
Barrow Island Marine Management Area	~75 km
Eighty Mile Beach Marine Park	~340 km
Montebello Islands Marine Park	~65 km
Muiron Island Marine Management Area	~240 km
Ningaloo Marine Park	~260 km
Rowley Shoals Marine Park	~380 km

Further detail on these reserves is provided below and shown in Figure 3-17.

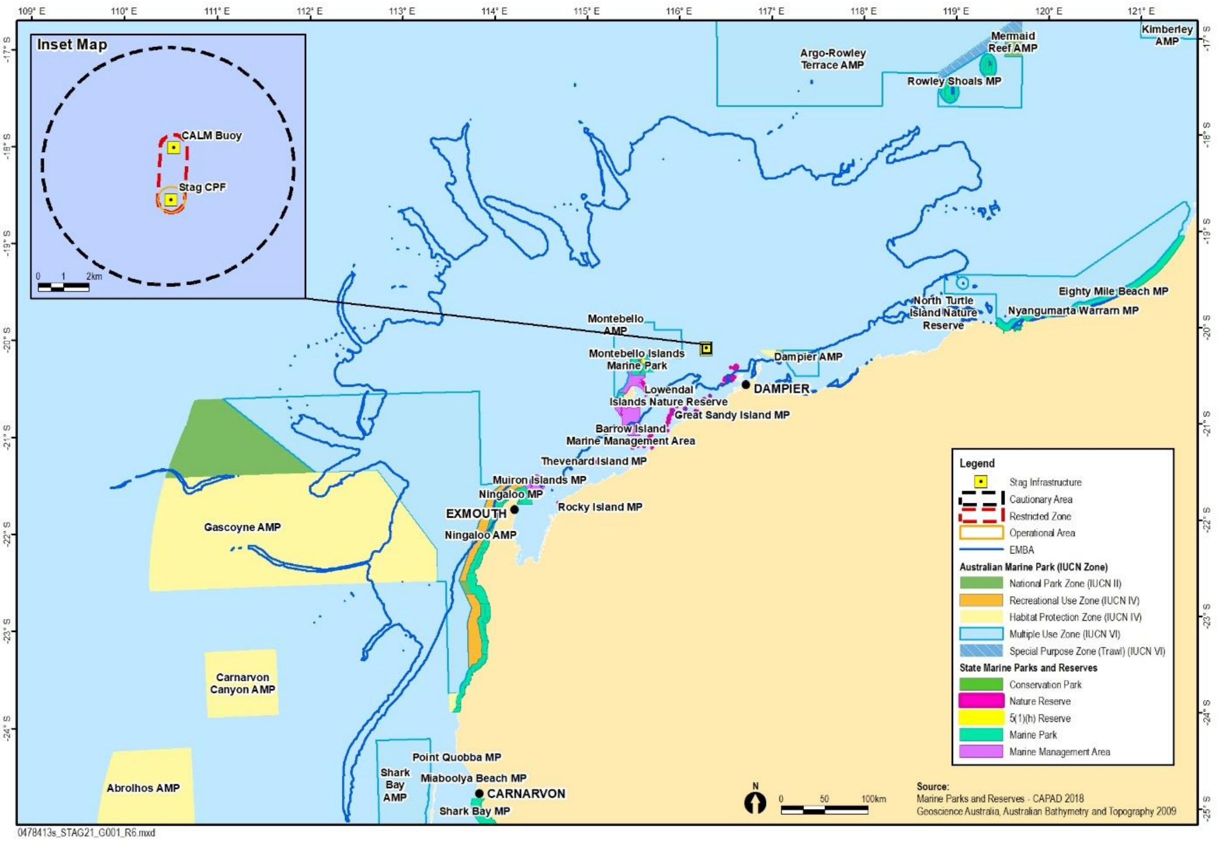

Figure 3-17: State Marine Reserves

3.8.1 Barrow Island Marine Park

The Barrow Island Marine Park covers 4,169 ha, all of which is zoned as sanctuary zone (the Western Barrow Island Sanctuary Zone) (DEC, 2007a). It includes Biggada Reef, an ecologically significant fringing reef, and Turtle Bay, an important turtle aggregation and breeding area (DEC, 2007a). Representative areas of seagrass, macroalgal and deep water habitat are also represented within the marine park (DEC, 2007a). Passive recreational activities (such as snorkelling, diving and boating) are permitted but extractive activities such as fishing and hunting are not.

3.8.2 Barrow Island Marine Management Area

The Barrow Island MMA is the largest reserve within the Montebello/Barrow Islands marine conservation reserves, covering 114,693 ha (DEC, 2007a). The MMA includes most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park, with the exclusion of the port areas of Barrow Island and Varanus Island.

The MMA is not zoned apart from one specific management zone: Bandicoot Bay Conservation Area. This conservation area is on the southern coast of Barrow Island and has been created to protect benthic fauna and seabirds. It includes the largest intertidal sand/mudflat community in the reserves, is known to be high in invertebrate diversity and is an important feeding area for migratory birds.

As for the other reserves in the Montebello/Barrow Islands marine conservation reserves, the Barrow Island MMA includes significant breeding and nesting areas for marine turtles and the waters support a diversity of tropical marine fauna, important coral reefs and unique mangrove communities (DEC, 2007a). Green, hawksbill and flatback turtles regularly use the island’s beaches for breeding, and loggerhead turtles are also occasionally sighted. The KPI for the marine park are summarised in Table 3-14.

3.8.3 Eighty Mile Beach Marine Park

The Eighty Mile Beach Marine Park covers an area of ~ 200,000 ha stretching for some 220 km from Cape Missiessy to Cape Keraudren, and includes sanctuary, recreation, general use and special purpose zones. The park is managed under the Eighty Mile Beach Marine Park Management Plan 2014-20124 (DBCA, 2014).

The listed ecological values of the Eighty Mile Beach Marine Park include the high sediment and water quality, the juxtaposition of the beach, coastal topography and seabed and the diverse and ecologically important habitats and marine/coastal flora and fauna. The listed values of the marine park are as follows:

- The intertidal sand and mudflat communities supporting a high abundance and diversity of invertebrate life and providing a valuable food source for shorebirds (including migratory species) and other fauna;
- The diverse subtidal filter-feeding communities;
- Macroalgal and seagrass communities providing habitat and feeding opportunities for fish, invertebrates and dugongs;
- High diversity intertidal and subtidal coral reef communities; and
- Mangrove communities and adjacent saltmarshes provide nutrients to the surrounding waters and habitat for fish and invertebrates.

The listed marine and coastal fauna values are as follows:

- A high diversity and abundance of nationally and internationally important shorebirds and waders (including migratory species) are found in the marine park;
- Flatback turtles are endemic to northern Australia and nest at Eighty Mile Beach;
- Dugongs and several whale and dolphin species inhabit or migrate through the marine park;
- A highly diverse marine invertebrate fauna provides an important food source for a variety of animals, including birds, fish and turtles, along with recreational and commercial fishing opportunities;
- A diversity of fish species provide recreational and commercial fishing opportunities; and
- A diversity of sharks and rays, including several protected species, are found in the park.

In addition to these natural values, the marine park contains land and sea important to traditional indigenous owners through identity and place, family networks, spiritual practice and resource gathering. The marine park also has a history of European activity including exploration, pastoralism and commercial fishing (e.g. the pearl oyster fishery). The park contains a historical WWII plane wreck (Dornier Do-24 X-36) and shipwrecks (two pearl luggers). The marine park provides tourism opportunity and recreational value through its remoteness, diversity and abundance of habitats and marine fauna and the pristine nature of the marine and coastal environment.

The marine park contains vast intertidal sand and mudflats that extend up to 4 km wide at low tide and provide a rich source of food for many species. Eighty Mile Beach Marine Park is one of the world's most important feeding grounds for small wading birds that migrate to the area each summer, travelling from countries thousands of kilometres away (DBCA 2014).

Further information on management zoning, cultural, ecological, social and economic values of the marine park are available in the Management Plan (DBCA 2014). The KPI for the marine park are summarised in Table 3-14.

3.8.4 Montebello/ Barrow Islands Marine Conservation Reserves

Montebello/Barrow Islands Marine Conservation Reserves encompasses three separate reserves: Barrow Island Marine Management Area; Barrow Island Marine Park; and Montebello Islands Marine Park.

As outlined in the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserve 2007–2017 (DEC 2007), the strategic conservation objectives for Reserve are to:

- Maintain and enhance the marine biodiversity of the reserves; and
- Maintain the ecological integrity (i.e. ecosystem structure and function).

While macroalgae-dominated limestone reef and subtidal reef platform/sand mosaic are the main marine habitat types in the Montebello/Barrow islands region, coral reef, mangroves and subtidal sand and soft-bottom habitats are also common. Macroalgal communities, which are the major primary producer for the area, mainly comprise species of brown algae, particularly of the genera Sargassum, Turbinaria and Pandina, while green algae from the genera Caulerpa and Cladophora are also abundant. A wide range of invertebrate life is associated with this habitat. The subtidal coral reef communities in the reserves have a high diversity of invertebrates, with at least 150 species of hard corals recorded from fringing and patch coral reef areas. Sand habitats are generally unvegetated but may have seasonal vegetation or permanent patches of seagrass or macroalgae and a significant invertebrate fauna. Rocky shores are typically undercut, unvegetated, low limestone cliffs, which support a variety of mollusc species and other invertebrates. The six species of mangroves that occur in the reserves represent the unique offshore mangrove communities of the Pilbara, and are considered to be globally significant (Semeniuk, 1997 as cited in EPA 2001). Mangrove communities support a range of invertebrate fauna and provide nursery habitat for fishes and crustaceans. The benthic and shoreline habitats in the reserves are shown in Figure 3-4.

Five of the six species of marine turtle found in WA have been recorded in the reserves. Of these, green, hawksbill and flatback turtles regularly nest on the sandy beaches in the reserves, while occasional nesting by loggerheads has also been recorded on Barrow Island. The WA hawksbill turtle population is the only large population of this species remaining in the Indian Ocean. The nesting populations of green and flatback turtles in the reserves are large and significant. The northernmost breeding limit for loggerheads in WA is within the reserves.

Seven species of toothed whale and three species of baleen whale have been recorded from the Montebello/Barrow islands region. Humpback whales use the reserves as a resting area, and some whale migration paths pass through the reserves. Dugongs are found in the vicinity of the Montebello Islands, Lowendal Islands and Barrow Shoals, where they feed on seagrass and algae. The Montebello/Barrow islands region is a significant rookery for at least 15 seabird species, with the largest breeding colony of roseate terns in Western Australia found on the Montebello Islands.

The KPI for the marine park are summarised in Table 3-14.

3.8.4.2 Montebello Islands Marine Park

The Montebello Islands Marine Park (MP) is an 'A' Class reserve (DEC 2007a) and covers an area of ~ 58,300 ha (DEC 2007a). Zoning within the Montebello Islands MP is a combination of sanctuary, recreation, special purpose (benthic protection), special purpose (pearling) and general use (DEC 2007).

The Montebello Islands comprise over 100 islands, the majority of which are rocky outcrops. The rocky shore accounts for 81% of shoreline habitat (DEC 2007a). Other marine habitats within the marine park include coral reefs, mangroves, intertidal flats, extensive sheltered lagoonal waters and shallow algal and seagrass reef platforms extending to the south of the Montebello Islands to the Rowley Shelf. The complex seabed and island topography create a unique environment in which these diverse habitats occur in close proximity to each other.

Ecologically, the marine park's values include important turtle nesting sites, feeding and resting areas for migrating shorebirds, seabird nesting areas, dugong foraging areas, globally unique mangrove communities and highly diverse fish and invertebrate assemblages (DEC 2007a). Also, the sediment and water quality of the marine park are considered pristine (DEC 2007a) and are essential to the maintenance of the marine ecosystems and associated biota. The KPI for the marine park are summarised in Table 3-14.

Economic values within the Montebello Islands MP include commercial pearl culture, commercial line and trap fishing and an increasing recreational usage. Special purpose zones for pearling are established for the existing leaseholder to allow pearling to be the priority use of these areas (DEC 2007). Commercial fishing includes a trap fishery for reef fishes, mainly in water depths of 30–100 m, and wet lining for reef fish and mackerel. Fish trawling also occurs in the waters near to the Montebello Islands. A tourist houseboat operates out of Claret Bay, at the southern end of Hermite Island, during the winter months. The Montebello Islands are becoming more frequently used by recreational boaters for camping, fishing and diving activities.

3.8.5 Muiron Island Marine Management Area

The Marine Management Area for the Muiron Islands is located immediately adjacent to the northern end of the Ningaloo Marine Park. This is managed as an integrated area together with the Ningaloo Marine Park under the Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 - 2015 (DEC 2005).

Muiron Islands located 15 km northeast of North-West Cape (NWC) and comprise the North and South Muiron Islands and cover an area of 1,400 ha (AHC, 2006). They are low limestone islands (maximum height of 18 m above sea level (ASL)) with some areas of sandy beaches, macroalgae and seagrass beds in the shallow waters (particularly on the eastern sides) and coral reef up to depths of 5 m, which surrounds both sides of South Muiron Island and the eastern side of North Muiron Island. The Muiron Islands Marine Management Area (MMA) was WA’s first marine management area, gazetted in November 2004. It covers an area of 28,616 ha and occurs entirely within state waters (CALM, 2005a).

3.8.6 Ningaloo Marine Park

The Ningaloo Marine Park was declared in May 1987 under the National Parks and Wildlife Conservation Act 1975 (Cmlth). The Ningaloo Coast, incorporating both key marine and terrestrial values was later granted World Heritage Status in June 2011. In November 2012, the Ningaloo Marine Park (Commonwealth Waters) was renamed to be incorporated in the North-west Australian Marine Park Network (5.7.6). The park covers an area of 263,343 km^2, including both State and Commonwealth waters, extending 25 km offshore. It is vested in the Marine Parks and Reserves Authority (MPRA) and managed by the WA Department of Biodiversity, Conservation and Attractions (DBCA) on behalf of the Commonwealth.

The park protects a large portion of Ningaloo Reef, which stretches over 300 km from North-West Cape south to Red Bluff. It is the largest fringing coral reef in Australia, forming a discontinuous barrier that encloses a lagoon that varies in width from 200 m to 7 km. Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (CALM 2005). The Ningaloo Marine Park forms the backbone of the nature-based tourism industry, and recreational activities in the Exmouth region. Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral attract large numbers of visitors to Ningaloo each year (CALM 2005).

The reef is composed of partially dissected basement platform of Pleistocene marine or Aeolian sediments or tertiary limestone, covered by a thin layer of living or dead coral or macroalgae. Key features that characterise the Ningaloo Reef include (CALM 2005):

- Over 217 species of coral (representing 54 genera);
- Over 600 species of mollusc (clams, oysters, octopus, cuttlefish, snails);
- Over 460 species of fish;
- Ninety-seven species of echinoderms (sea stars, sea urchins, sea cucumbers);
- Habitat for numerous threatened species, including whales, dugong, whale sharks and turtles; and

- Habitat for over 25 species of migratory wading birds listed in CAMBA and JAMBA.

The strategic conservation objectives for Ningaloo Marine Park and the Muiron Islands Marine Management Area are:

- Maintain the marine biodiversity of the reserves; and
- Maintain ecological processes and life support systems (i.e. key ecosystem structure and function).
- To attain these objectives, some of the social and ecological values are monitored as Key Performance Indicators (KPI) including, coral reef communities, water quality, coastal biological communities, finfish, mangrove communities, turtles, Intertidal sand and mudflat communities, Seascapes and Wilderness (Table 3-14).

3.8.7 Rowley Shoals Marine Park

The Rowley Shoals comprise three oceanic reef systems approximately 30–40 km apart, namely Mermaid Reef, Clerke Reef and Imperieuse Reef (DEC, 2007b). The Rowley Shoals Marine Park comprises the Clerke and Imperieuse Reefs which lie in State Waters. The Rowley Shoals Marine Park was originally gazetted on 25 May 1990 as a Class A reserve and on 10 December 2004 the boundary was amended to extend the Park to the State Waters limit (DEC, 2007b). The Park now covers approximately 87,632 ha (DEC, 2007b). Mermaid Reef lies in Commonwealth waters and comprises the Mermaid Reef Marine National Nature Reserve managed by the Commonwealth Department of Agriculture, Water and Energy (DAWE) (DEWHA 2008).

The Rowley Shoals Marine Park is characterised by intertidal and subtidal coral reefs, diverse marine fauna and high water quality. These attributes and the low level of use of the area contribute to the Park's unique wilderness qualities, which are a significant draw card for visitors. Due to contrasting depths, the Rowley Shoals supports a diverse marine invertebrate community including a number of endemic species. Invertebrate species (excluding corals) at the Rowley Shoals include sponges, cnidarians (jellyfish, anemones), worms, bryozoans (sea mosses), crustaceans (crabs, lobsters, etc.), molluscs (cuttlefish, baler shells, giant clams, etc.), echinoderms (starfish, sea urchins) and sea squirts (DEC & MPRA 2007b). The remoteness of the Shoals and low use have ensured that the marine environment of the Shoals is in a near natural state, particularly relative to other reefs in the Indo-West Pacific region which are subject to intense ongoing human pressures and destructive fishing practices.

Imperieuse Reef is 16 km x 8 km and includes a small sand cay ~3.7 m high and devoid of vegetation (Cunningham Islet) within the northern extremity of the reef. The south-eastern edge has coral boulders that rise 3 m above the water mark while large areas of the reef dry out at low water and there are two lagoons contain coral patches within. Clerke Reef lays 23 km north-west of Imperieuse Reef and is 15 km x 6 km in size. Near the northern end of the reef lies Bedwell Islet, a bare sand cay about 2 m high which is a nesting site for the red-tailed tropic bird (DEC 2007). On the eastern and western sides of the reef there are a number of boulders which fall dry. A narrow passage leads to a lagoon, with many detached coral patches within the reef.

The major habitats of the area include intertidal and subtidal reefs that comprise the typical coral atoll formation and are home to many reef-associated species. Surveys carried out by the Western Australian Museum identified 184 species of corals, primarily Indo-West Pacific species, indicating the strong affinity of the Rowley Shoals communities with Indonesia. In terms of other species, at least 264 species of molluscs, 82 species of echinoderms and 389 species of finfish were also identified. Many of these records were new to WA, reflecting the significant differences between the offshore Indo-Pacific fauna and inshore WA coastal fauna. The faunal assemblages of the Rowley Shoals Marine Park are regionally significant as they contain large numbers of species not found in the more turbid coastal environments of tropical Western Australia (DEC 2007).

Sparse seagrass is found within subtidal coral reef communities of the Rowley Shoals but is not a major habitat type. Although macroalgae is present at the Rowley Shoals, it is not recognised as a key habitat component in the Mermaid Reef Marine National Nature Reserve Plan of Management (EA 2000) or the Rowley Shoals Marine Park Management Plan (DEC & MPRA 2007b) and there is nothing to suggest that it is unique within the Indo-Pacific (Huisman et al. 2009).

The Rowley Shoals are a known foraging area for migratory birds, foraging area for the green and hawksbill turtle, and provide habitat to numerous sharks.

The Rowley Shoals are of national and international significance and provide an important global benchmark for Indo-West Pacific reefs (DEC 2007). Further information is available in the Rowley Shoals Marine Park Management Plan 2007-2017 (DEC 2007). The KPI for the marine park are summarised in Table 3-14.

3.8.8 Summary of Values and Sensitivities for State Marine Reserves within the Operational Area and EMBA

Table 3-14: Summary of Environmental Values and Sensitivities for State Marine Reserves within the Operational Area and EMBA

State Marine Reserves	Environmental value	KPI's	Sensitivities within the Operational Area	Sensitivities within the EMBA
Barrow Island Marine Park	Includes Biggada Reef, an ecologically significant fringing reef, and Turtle Bay, an important turtle aggregation and breeding area. Includes representative areas of seagrass, macroalgal and deepwater habitat.	Coral reef communities Mangrove communities Macroalgae and seagrass Turtles Fin fish Water quality	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles)
Barrow Island Marine Management Area	Includes most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park. Includes Bandicoot Bay Conservation Area on the southern coast of Barrow Island created to protect benthic fauna and seabirds. It includes the largest intertidal sand/mudflat community in the reserves and is an important feeding area for migratory birds. Includes significant breeding and nesting areas for marine turtles, important coral reefs and unique mangrove communities.	Coral reef communities Mangrove communities Macroalgae and seagrass Turtles Fin fish Water quality	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles and migratory shorebirds)

Eighty-mile Beach Marine Park	Contains Ramsar site and one of the world's most important feeding grounds for migratory shorebirds and wetland birds. Also supports dugongs, inshore dolphins, sharks, rays, tropical fish, sponges, coral reefs and several threatened turtle species. Significant nesting population of flatback turtles within the park.	Intertidal sand and mudflat communities Mangrove communities and salt marshes Waterbirds including migratory species Marine turtles (also see species info on other tab) Scalefish Remote seascapes	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles, dugongs, dolphins and migratory shorebirds).
Montebello Island Marine Park	Comprise over 100 islands, with habitats including rocky shorelines, coral reefs, mangroves, intertidal flats, extensive sheltered lagunal waters, and shallow algal and seagrass reef platform. Contains important nesting/breeding and foraging sites for turtles, nesting and resting areas for migrating shorebirds, seabird nesting areas, dugong foraging areas, globally unique mangrove communities, and highly diverse fish and invertebrate assemblages.	Coral reef communities Mangrove communities Macroalgae and seagrass Turtles Fin fish Water quality	**No**	**Yes –** oil could potentially reach shoreline, intertidal and shallow subtidal habitats as well as Marine species using these habitats (e.g. turtles, seabirds, shorebirds, dugongs)
Muiron Island Marine Management Area	Adjacent to Ningaloo Marine Park around Muiron Island. Regionally significant loggerhead turtle nesting beaches. Contains coral reef and macroalgae habitat.	Coral reef communities Water quality Coastal biological communities Finfish Mangrove communities Turtles	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles) or aggregating/migrating offshore from these habitats (whale sharks and whales)

		Seascapes Wilderness		
Ningaloo Marine Park	Extensive fringing reef and lagoonal system. Supports high diversity of corals, molluscs, fish, crustaceans and sponges. Important habitat for protected and iconic turtles (foraging and nesting), whales (migrating and resting) and whale sharks (feeding aggregations) as well as sea and shorebirds.	Coral reef communities Water quality Coastal biological communities Finfish Mangrove communities Turtles Seascapes Wilderness	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles and migratory shorebirds) or aggregating/migrating offshore from these habitats (whale sharks and whales)
Rowley Shoals Marine Park	Comprises the Clerke and Imperieuse Reefs. Characterised by intertidal and subtidal coral reefs, rich and diverse marine fauna and high water quality. Shoals are thought to provide a source of invertebrate and fish recruits for reefs further south and as such are regionally significant The Rowley Shoals provide an important global benchmark for Indo- West Pacific reefs	Water quality Intertidal coral reef communities Subtidal reef communities Invertebrates Fin fish Seascapes Wilderness	**No**	**Yes –** oil could potentially reach and coat shoreline, intertidal and shallow subtidal habitats as well as marine species using these habitats (e.g. turtles, seabirds, cetaceans)

3.9 Socio-Economic Environment

The Stag Field is approximately 60 km offshore from the Port of Dampier. Smaller coastal fishing and tourism settlements occur at Onslow, approximately 200 km to the south, and Point Samson, some 100 km to the southeast.

Dampier, Karratha and Port Hedland are the main service and population centres for the region. Although initially developed for the iron ore industry, these towns have expanded to service the oil and gas industry located on the NWS.

3.9.1 Commercial Fisheries and Aquaculture

Offshore and coastal waters in the NWS region support a valuable and diverse commercial fishing industry, dominated by Pilbara fisheries. The major fisheries in the Pilbara region target tropical finfish, large pelagic fish species, crustaceans (prawns and scampi) and pearl oysters (AFMA, 2011; Fletcher and Santoro, 2013). A summary of fisheries resources is provided in Table 3-15.

<u>Commonwealth Fisheries</u>

Commonwealth fisheries are those within the 200-nautical mile Australian Fishing Zone (AFZ) managed by Australian Fisheries Management Authority (AFMA) and are, on the high seas, and, in some cases, by agreement with the States and Territory, to the low water mark. Commonwealth managed fisheries are permitted to operate within Stag Operational area (not including restricted zone) and EMBA, but effective fishing effort is either non-existent or of very limited nature (Table 3-17).

The North-West Slope Trawl Fishery (NWSTF) fishery is limited to waters deeper than 200 m isobath and so does not overlap the operational area, although it did have active fishing in 2014/2015 within the EMBA. It must be noted that only one vessel was active (CoA 2016).

The boundary of the Western Deepwater Trawl Fishery (WDTF) management area is more than 100 km from the operational area but is overlapped by the EMBA. However, no fishing was undertaken in the 14/15 season, and prior to that, effort was south off Shark Bay and limited to only three vessels (CoA 2016).

Other Commonwealth fisheries, such as the Western Tuna and Billfish Fishery (WTBF), Southern Bluefin Tuna Fishery (SBFTF) and the Skipjack Tuna Fishery (Western; WSTF), although licenced to fish in the region, have had no historical fishing effort reported near the Operational Area or within the EMBA (CoA 2016).

A summary of Commonwealth managed fisheries operating in the vicinity of the Stag Facility is provided in Table 3-17 and Figure 3-18.

<u>State Fisheries</u>

State fisheries are managed by the WA Department of Primary Industries and Regional Development (DPIRD) with specific management plans, regulations and a variety of subsidiary regulatory instruments under the Fish Resources Management Act 1994 (WA). The information provided on State managed fisheries has been derived from the State of Fisheries Report 2014/2015 (Fletcher and Santoro, 2015). Commercial fishery zones that have boundaries that overlap the Stag Facility Operational Area are listed below, presented in Figure 3-19 and summarised in Table 3-18.

North Coast Bioregion

- Onslow Prawn Managed Fishery (OPMF);
- Mackerel Managed Fishery (all areas) (MF);
- Pilbara Demersal Scalefish Fishery (Line, Trap and Trawl);
- Pearl Oyster Managed Fishery; and
- Pilbara Developing Crab Fishery.

Whole of State Fisheries

- Beche-de-mer Fishery;
- Marine Aquarium Fish Fishery; and
- Specimen Shell Managed Fishery.

While some fisheries have permitted fishing zones that overlap the Operational Area (Figure 3-19), not all have significant fishing effort in this (Table 3-17). The Stag location is too deep for any dive based fisheries (i.e. Pearl Oyster, Roe’s Abalone, Beche-de-Mer, Marine Aquarium Fish, Specimen Shell Fishery), is too far offshore for the prawn Fisheries and does not contain seabed features or reef that attract target species within the Mackerel Fishery or Pilbara Trap Fishery. The Operational Area also represents a 500m restricted zone around Stag Facility infrastructure where fishing is prohibited.

Fisheries that do not overlap the operational area but are overlapped by the EMBA include:

North Coast Bioregion

- Nickol Bay Prawn Managed Fishery (NBMF);
- Broome Prawn Managed Fishery (BMF);
- The Kimberley Gillnet and Barramundi Managed Fishery (KGBF);
- Northern Demersal Scalefish Managed Fishery (NDSF);
- WA North Coast Shark Fishery; and
- Pilbara Developing crab Fishery.

Gascoyne Coast Bioregion

- Exmouth Gulf Prawn Fishery;
- Gascoyne Demersal Scalefish Fishery.

West Coast Bioregion

- Roe’s Abalone Fishery; and
- West Coast Rock Lobster Managed Fishery.

Whole of State Fisheries

- West Coast Deep Sea Crab (Interim) Managed Fishery.

<u>Aquaculture</u>

The only aquaculture activity within the EMBA is pearl farming of pearl oysters (Pinctada maxima) in protected waters (Fletcher and Santoro, 2015). Pearl farm locations within the EMBA are at the Montebello Islands.

3.9.2 Recreational Fisheries

Recreational fisheries and charter boat operators are managed by the DPIRD; the area covered by the EMBA of this EP falls primarily within the North Coast Bioregion (Fletcher and Santoro, 2012). Within the North Coast Bioregion, recreational fishing is experiencing significant growth, with a distinct seasonal peak in winter when the local population increases significantly from tourists visiting the Exmouth/Onslow area and Dampier Archipelago (Fletcher and Santoro, 2012). Increased recreational fishing has also been attributed to those involved in the construction or operation of developments within the region. Offshore islands, coral reefs and continental shelf provide species of major recreational interest including saddletail snapper, red emperor, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish (Fletcher and Santoro, 2012). Advice received from DPIRD (pers. com. C. Telfer, in 2012) indicates that charter boat fishing effort in permit area WA-15-L has been recorded. Offshore shoals, such as Glomar Shoals and Rankin Bank attract occasional recreational and charter boat visitations, however these trips are generally of a short duration and sporadic. The distance of these destinations offshore means that only a limited number recreational fishing trips can be expected each year.

Within the Operational Area there are no known natural seabed features that would aggregate fishes and which are typically targeted by recreational fishers. However, the Stag CPF, pipeline, CALM buoy and associated vessels are likely to attract pelagic fish and therefore could also attract recreational fishers target pelagic species. Nevertheless, fishing in the immediate vicinity of the Stag facilities is not permitted since a 500 m Restricted Zone is in place. This could have an impact on requiring extra distance travelled when traversing the region, how this would be small compared to total distance travelled in any trip given the remoteness of the location.

Table 3-15: Fisheries Resources

North Coast Bioregion			
Fishery or resource	***Catch returns recorded in past 3 years (noting if any returns in NWS Bioregional province)***	***Are breeding stocks/ effort for target species in fishery acceptable?***	***Permitted fishing method***
North Coast Prawn Managed Fisheries (including Onslow Prawn Managed Fishery; Nickol Bay Prawn Managed Fishery; Broome Prawn Managed Fishery and Kimberley Prawn Managed Fishery)	Yes (including NWS)	Yes	Otter trawl
North Coast Nearshore and Estuarine Fishery resource (including Kimberley Gillnet & Barramundi Managed Fishery)	Yes	Yes	Gill net
North Coast Demersal Fisheries (including Pilbara Fish Trawl (Interim) Managed Fishery, Pilbara Trap and Line Managed Fishery and Northern Demersal Scalefish Managed Fishery)	Yes (including NWS)	Yes	Hand/ dropline, fish traps
Mackerel Managed Fishery	Yes (including NWS)	Yes	Trolling, jig or handline
Pearl Oyster Managed Fishery	Yes (including NWS)	Yes	Hand collection
Beche-de-mer Fishery	Yes (including NWS)	Yes	Hand collection
North Coast Crab Fishery (including Kimberley Developing Mud Crab Fishery and Pilbara Developmental Crab Fishery)	Yes (including NWS)	Yes	Baited traps, trawl
North-West Slope Trawl	Yes	Not reported	Trawl
Northern Prawn Fishery	Yes (note limited extent of fishery in Area of Interest)	Yes	Trawl
Skipjack Tuna Fishery			
Small Pelagic Fishery			
Southern Bluefin Tuna Fishery			
The Western Deepwater Trawl	Yes	Yes	Trawl
Western Tuna and Billfish Fishery (WTBF)	Yes	No (Striped Marlin overfished)	Longline

3.9.3 Oil and Gas Industry

The surrounding waters are also used for petroleum exploration and development. The nearest production activities to the Stag Facility include:

- Wandoo Production Platforms located in Exploration Permit WA-14-L, ~ 20 km northeast; and
- Gas pipelines run from the Reindeer platform (~ 29 km north) to the mainland (north to south). To the east (~ 6 km), another gas pipeline runs east to west, ~ 10 km north of the Stag Facility.

3.9.4 Commercial Shipping

Commercial shipping moves through the offshore waters en route to or from the marine terminals at Thevenard, Barrow and Varanus Islands. Shipping using NWS waters includes iron ore carriers, third-party tankers and other vessels proceeding to or from the ports of Dampier, Cape Preston, Port Walcott and Port Hedland; however, these are predominantly heading north from these ports. Large cargo vessels carrying freight bound or departing from Fremantle, transit along the WA coastline heading north and south in deeper waters. Shipping activities in relation to the Stag Operational Area are illustrated in Figure 3-20. The Stag platform is located 3.1 nautical miles (5.7 km) north-west of a shipping fairway that experiences heavy concentrations of commercial traffic as vessels transit into and out of Cape Preston and Barrow Island.

3.9.5 Tourism

Aquatic recreation such as boating, diving and fishing occurs near the coast and islands off the Pilbara and Ningaloo coast and to a lesser extent the Rowley Shoals. These activities are concentrated in the vicinity of the population centres such as Exmouth, Dampier and Onslow

Water-based tourism activities undertaken across NWS include:

- Whale watching;
- Recreational boating;
- Charter fishing;
- Snorkelling/diving;
- Surfing; and
- Recreational fishing.

In the waters immediately surrounding the Stag Facility, tourism activities are limited due to its distance from the mainland and island shorelines.

3.9.6 Native Title

Within the EMBA any sheen or impact on environmental values may impact the associated cultural values or use. Within the EMBA the following have been identified (NTT 2017):

- Schedule of Native Title Determination Applications;
- Register of Native Title Claims;
- Native Title Determinations;
- Register of Indigenous Land Use Agreements; and
- Notified Indigenous Land Use Agreements.

Native title determinations within the EMBA are summarised in Table 3-16.

Table 3-16: Native title determinations

Native Title Determinations	
Karajarri People (Area A)	Native title exists (exclusive)
Karajarri People (Area B)	Native title exists (non-exclusive)
Ngarluma/Yindjibarndi	Native title exists (non-exclusive)
Rubibi Community	Native title exists (non-exclusive)
Ngarla and Ngarla #2 (Determination Area A)	Native title exists (non-exclusive)
Registered Native Title Claims	
Yaburara & Mardudhunera People	Accepted for registration
Gnulli	Accepted for registration
Kariyarra People	Accepted for registration
Jabirr Jabirr	Accepted for registration
Goolarabooloo People	Accepted for registration
Bindunbur	Accepted for registration
Indigenous Land Use Agreements	
Yawuru Prescribed Body Corporate ILUA - Broome	ILUA registered
Yawuru Area Agreement ILUA	ILUA registered
RTIO Ngarluma Indigenous Land Use Agreement (Body Corporate Agreement)	ILUA registered
Kuruma Marthudunera and Yaburara and Coastal Mardudhunera Indigenous Land Use Agreement	ILUA registered
Anketell Port, Infrastructure Corridor and Industrial Estates Agreement	ILUA registered
Cape Preston Project Deed (YM Mardie ILUA)	ILUA registered
Yawuru Nagulagun / Roebuck Bay Marine Park ILUA	ILUA registered
FMG – Kariyarra Land Access ILUA	ILUA accepted for notification

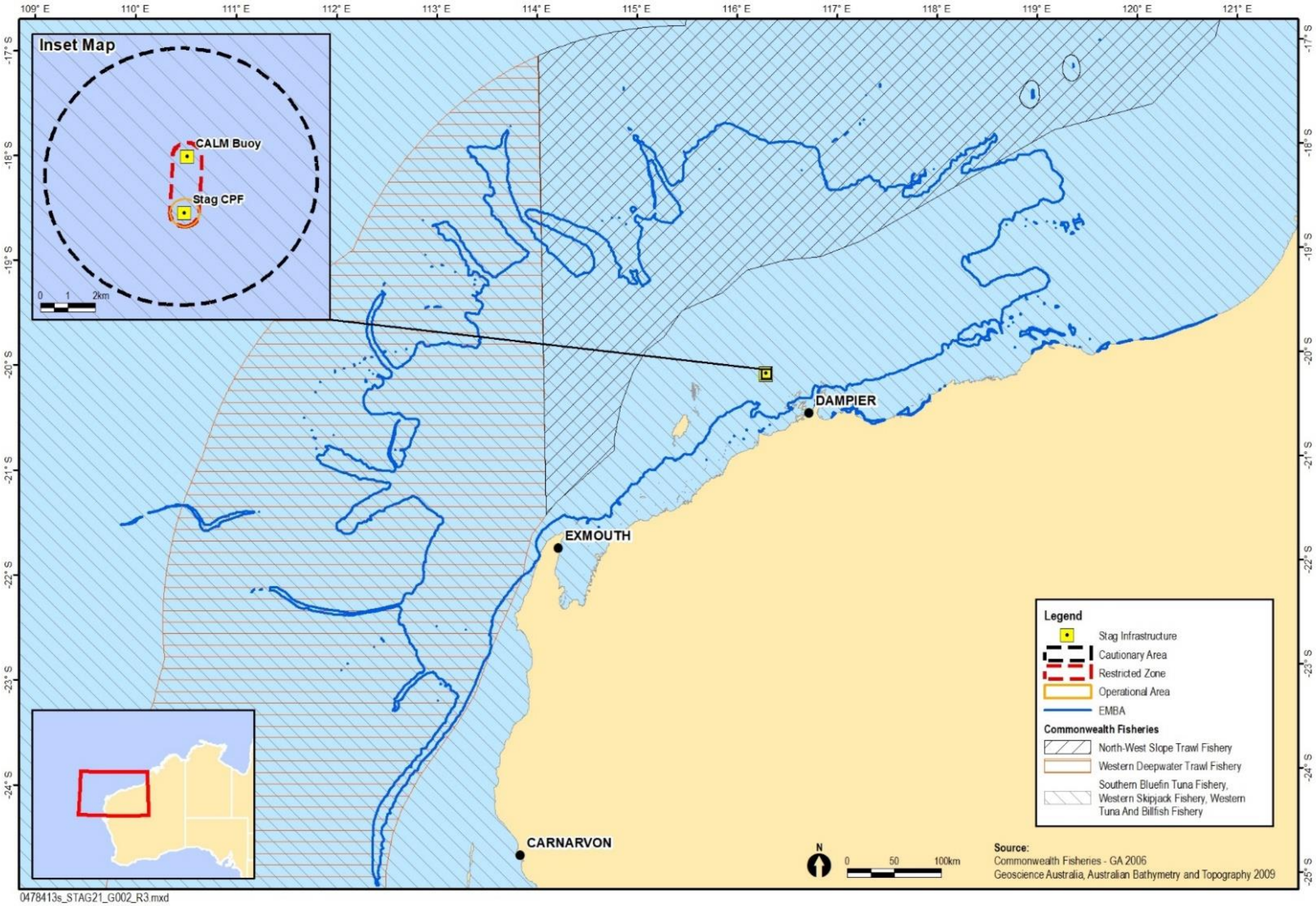

Figure 3-18: Commonwealth Commercial Fishing Zones in the vicinity of the Stag facility

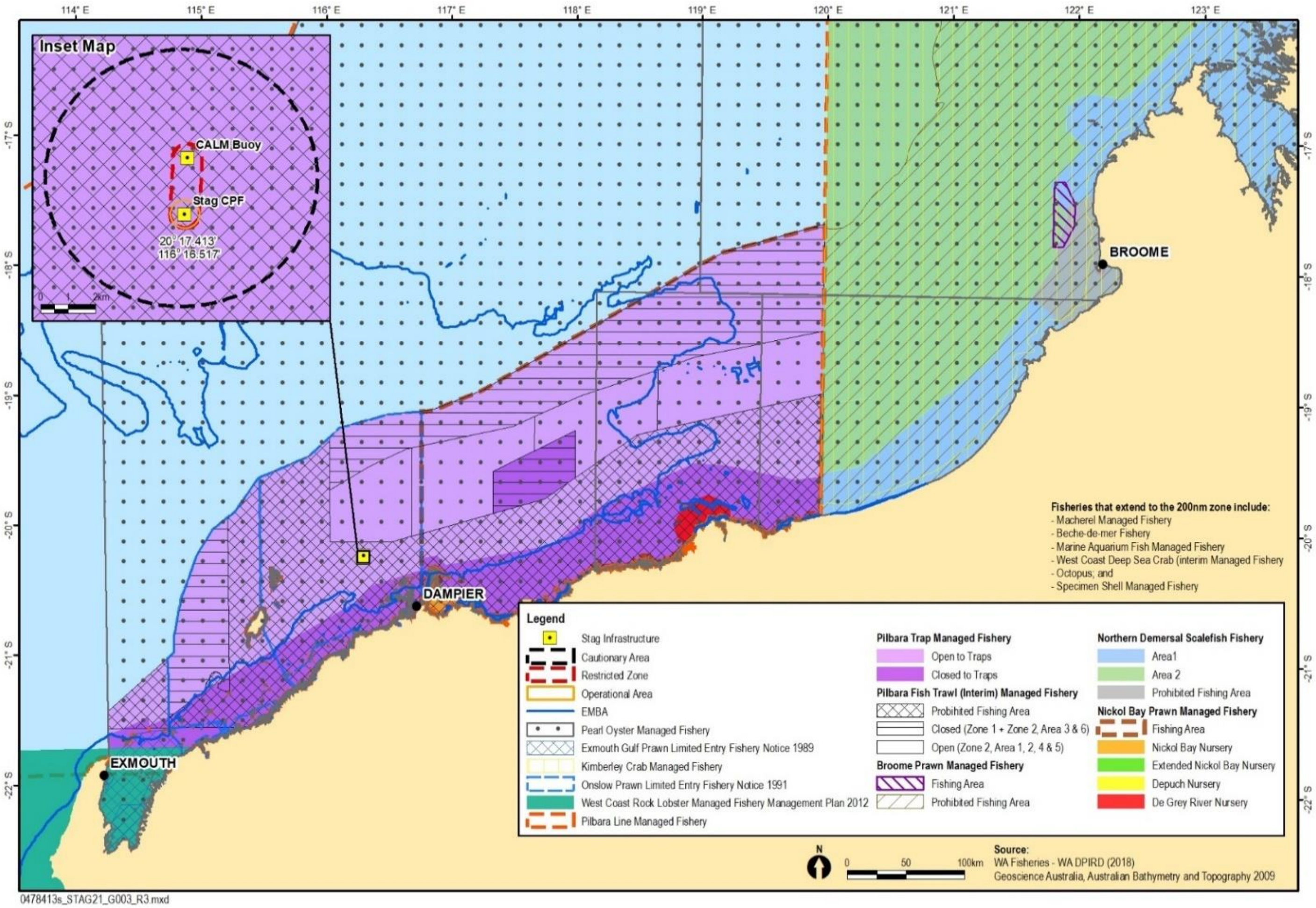

Figure 3-19: State Commercial Fishing Zones in the Vicinity of the Stag Facility

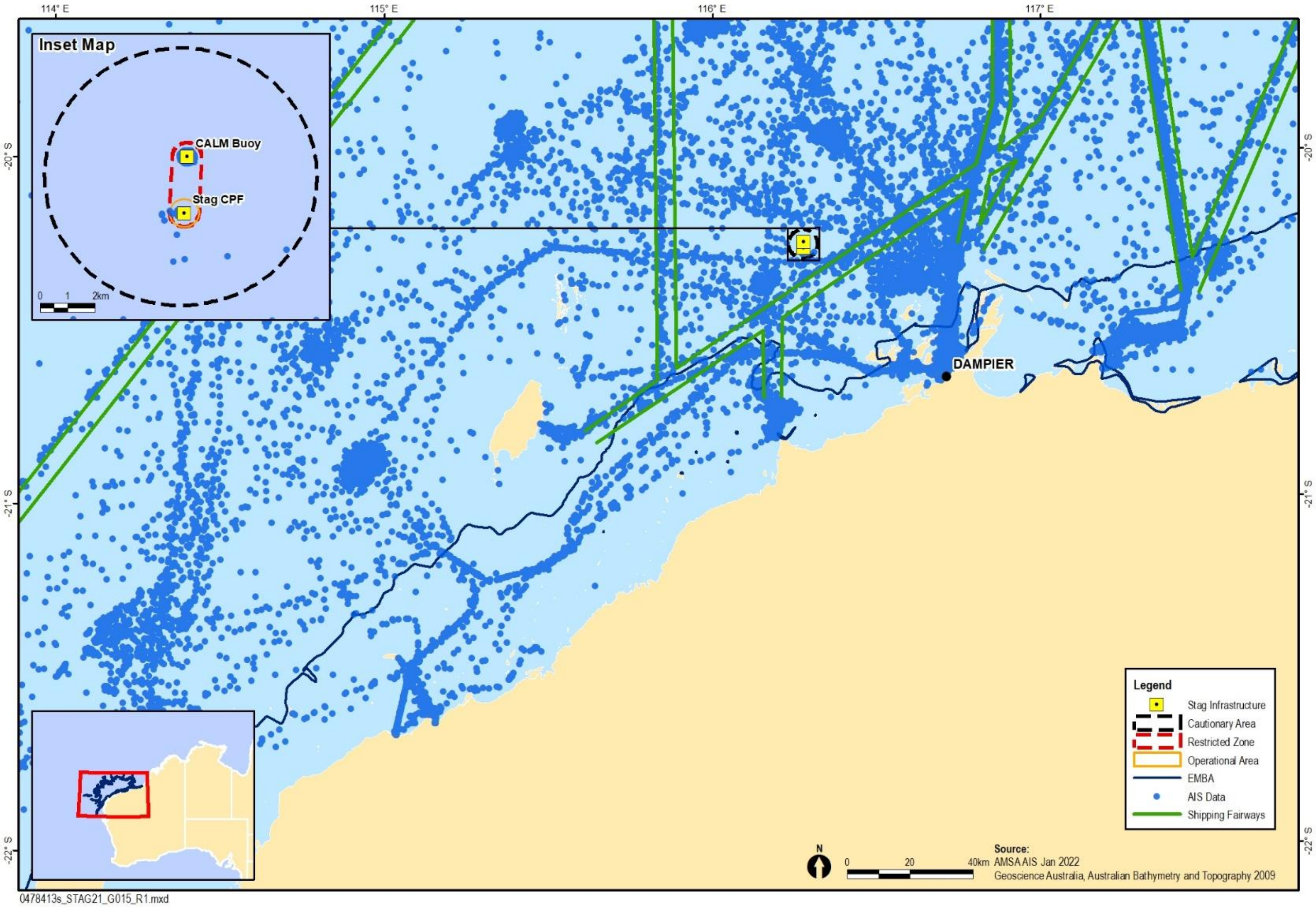

Figure 3-20: AMSA shipping records and designated shipping routes in the vicinity of the Operational Area

Table 3-17: Summary of Commercial Fisheries licences to fish in the vicinity of the Stag Facility Operational Area or EMBA

Fishery	Target Species	Fishing Method and Area
Commonwealth-managed Fisheries		
North-West Slope Trawl	Scampi (crayfish): primarily Australian (*Metanephrops australiensis*), with smaller quantities of velvet scampi (*M. velutinus*) and Boschmas scampi (*M. boschmai*). A quantity of prawns (Giant scarlet, red carid, red, red-striped and royal red prawns) is harvested each season, and squids are becoming an increasingly significant component of the catch Mixed snappers (Lutjanidae) and redspot emperor (Lethrinus lentjan) have also been important components of the catch historically.	Demersal trawl operates in north-western Australia from 114°E to 125°E, seaward of the 200m isobath, but no current effort in vicinity of the operational area and limited effort within EMBA. 6 vessels operated in 2019-20 season (4 in 2018-19).
Western Deepwater Trawl	Deepwater bugs (*Ibacus* spp). and ruby snapper (*Etelis* sp) dominating recent catches.	Demersal trawl seaward of the 200m isobath, and west of North-West Cape – does not overlap operational area, but small overlap of EMBA. Effort in recent years has been localized in the area offshore and slightly south of Shark Bay and limited to only three vessels.
Western Skipjack	Skipjack tuna (*Katsuwonus pelamis*) is the only target species. Landings of species other than skipjack (may include bigeye (*Thunnus obesus*), and yellowfin tuna (*T. albacares*).	Purse seine November to June. A small amount of pole and line effort is also used. Historically fishing limited to waters off SA and not WA. No fishing effort since 2008-2009 (CoA 2016)
Western Tuna and Billfish	Bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), albacore (*T. alalunga*) and swordfish (*Xiphias gladius*). Striped marlin (*Kajikia audax*)is a minor component of the catch but remains an important species for management due to historically higher catches.	Pelagic longline year-round with low-levels of minor-line fishing. In recent years, fishing effort has concentrated off south-west Western Australia, with occasional activity off South AustraliaNo current effort on the NWS.
Southern Bluefin Tuna	Southern bluefin tuna (*Thunnus maccoyii*).	Most of the Australian catch is taken by purse-seine vessels in the Great Australian. No current effort on the NWS.
State-managed Fisheries		
Onslow Prawn Managed Fishery	Western king prawn (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*) and endeavour prawns (*Metapenaeus* spp.)	Low-opening otter trawls used within the boundaries of the OPMF being 'all the Western Australian waters between the Exmouth Prawn

Fishery	Target Species	Fishing Method and Area
		Fishery and the Nickol Bay prawn fishery between 114º39.9' east and 116º45' on the landward side of the 200m depth isobath. One boat fished in the OPMF in 2019 whilst the other operators chose to fish elsewhere where catches were likely to be more profitable One vessel fished for 28 days in 2019.
Nickol Bay Prawn Managed Fishery	Primarily targets banana prawns (*Penaeus merguiensis*)	High opening otter trawls used within the boundaries of the NBPMF being 'all the waters of the Indian Ocean and Nickol Bay between 115°26' east longitude and 120° east longitude on the landward side of the 200m isobath. 9 vessels fished intermittently in 2021 as per DPIRD catch data.
Broome Prawn Managed Fishery	Western king prawns (*Penaeus latisulcatus*) and coral prawns (a combined category of small penaeid species)	Low opening otter trawls used within the boundaries of the BPF being all Western Australian waters of the Indian Ocean lying east of 120° east longitude and west of 123°45' east longitude on the landward side of the 200m isobath. Only one vessel undertook trial fishing in 2019.
The Kimberley Gillnet and Barramundi Managed Fishery (KGBF)	Primarily Barramundi (*Lates calcarifer*), king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*). Small quantities of Elasmobranchs (sharks and rays), black jewfish (*Protonibea diacanthus*) and tripletail (*Lobotes surinamensis*) are also landed.	It encompasses the taking of any fish by gillnet in inshore waters and the taking of barramundi (Lates calcarifer) by any means. Operates in the nearshore and estuarine zones of the North Coast Bioregion from the WA/NT border (129ºE) to the top end of Eighty Mile Beach, south of Broome (19ºS). Access to the KGBF is limited to four licences. Commercial fishing is now prohibited between Roebuck Bay and the northern end of Eighty Mile Beach to 19ºS as well as within three nautical miles of the high water mark and around major town sites and recreationally important fishing locations.
Northern Demersal Scalefish Managed Fishery (NDSF)	The main species landed by this fishery are red emperor and goldband snapper and saddletail snapper.	Demersal traps are used within waters off the north coast of Western Australia east of longitude 120°E. These waters extend out to the edge of the Australian Fishing Zone.

Fishery	Target Species	Fishing Method and Area
Mackerel Managed Fishery	Spanish (*Scomberomorus commerson*) and grey mackerel (*S. semifasciatus*).	Trolling or handline year-round in all waters to the 200-nautical mile AFZ between 114º E to 121º. Catch data was requested from DPRID for the last 5 years (2016-2021) for the 10x10nM reporting grid (block 201161) in which the operational area sits. During this time less than 3 vessels in the Mackerel Managed Fishery were active in this grid (catch not able to be reported due to the low numbers).
Pilbara Demersal Scalefish Fishery (Line, Trawl and Trap)	Variety of demersal scalefish landed including goldband snapper (*Pristipomoides multidens*), red emperor (*Lutjanus sebae*) and bluespotted emperor (*Lethrinus punctulatus*) and rankin cod (*Epinephelus multinotatus*).	Fishing within waters off the north coast of Western Australia west of longitude 120°E. Across the whole of PDSF the commercial catches for 2019were demersal trawl (72%), trap (23%) and line (5%). This fishery operates accross various zones and year-round. The trawl sector of the fishery is closed within operational area, but trap fishing is permitted. Although 5 vessels operated within the 10x10nM block in the PDSF trawl fishery (total catch 50,599kg over 5 years), as the operational area is part of a closed area for this fishery (the closure boundary runs through the middle of this block) it is known that this catch was not from the area of the proposed activity. In the broader 60x60nM block 3 vessels were active in the Trap Fishery (241,412kg catch over 5 years); and 6 vessels in the line fishery (19,748kg catch over 5 years).
Pearl Oyster Managed Fishery	Silver-lipped pearl oyster (*Pinctada maxima*)	Drift diving restricted to shallow divable depths generally less than 35 m In 2019 catch was taken from Zones 2 only with no fishing in Zones 1 or 3
WA North Coast Shark Fishery	Sandbar (*Carcharhinus plumbeus*), blacktip (*Carcharhinus* spp.), tiger (*Galeocerdo cuvier*) and lemon (*Negaprion acutidens*) sharks	Area between North-West Cape and a line of longitude at 120° E and all waters south of latitude 18° S has been closed indefinitely to protect shark stocks.

Fishery	Target Species	Fishing Method and Area
Pilbara Crab Managed Fishery	Blue swimmer crab (*Portunus armatus*)	Hourglass traps used in inshore waters from Onslow through to Port Hedland with most commercial and activity occurring in and around Nickol Bay. 3 vessels were used in 2020.
Exmouth Gulf Prawn Fishery	Target western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), blue endeavour prawns (*Metapenaeus endeavouri*) and banana prawns (*Penaeus merguiensis*).	Otter trawls used within Exmouth Gulf. In 2020, 6 boats trawled.
Gascoyne Demersal Scalefish Fishery	A range of demersal species including pink snapper (*Pagrus auratus*), goldband snapper (*Pristipomoides* spp., mainly *P. multidens*), red emperor (*Lutjanus sebae*), emperors (Lethrinidae, includes spangled emperor, *Lethrinus nebulosus*, and redthroat emperor, *L. miniatus*), cods (Serranidae), ruby snapper (*Etelis carbunculus*), pearl perch (*Glaucosoma burgeri*), mulloway (*Argyrosomus japonicus*), amberjack (*Seriola dumerili*) and trevallies (Carangidae).	The GDSF licensed vessels fish throughout the year with mechanised handlines in the waters of the Indian Ocean and Shark Bay between latitudes 23°07’30”S and 26°30’S. Peak fishing period for pink snapper is June-July when the oceanic stock aggregates to spawn. In 2019, 9 vessels actively fished.
West Coast Rock Lobster Managed Fishery	Western rock lobster (*Panulirus cygnus*)	Baited pots fished along the west coast of Australia. between Latitudes 21°44´ to 34°24´ S
Beche-de-mer (Sea Cucumber) Managed Fishery	Sandfish (*Holothuria scabra*) and deepwater redfish (*Actinopyga echinites*).	Hand-harvest fishery, animals caught principally by diving (restricted to diving depths) and a smaller amount by wading. 3 vessels operated in 2021 as per DPIRD catch data.
Marine Aquarium Fish Managed Fishery	Fish, coral, algae, live rock	Dive based fishery operating all year throughout WA waters, but restricted by diving depths. The fishery is typically more active in waters south of Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth, Dampier and Broome. 7 vessels operated in 2021 as per DPIRD catch data.

Fishery	Target Species	Fishing Method and Area
Specimen Shell Managed Fishery	Shells (cowries, cones)	Dive based fishery operating all year throughout WA waters, but restricted by diving depths. 3 vessels operated in 2021 as per DPIRD catch data.
West Coast Deep Sea Crustacean Managed Fishery	Crystal (Snow) crabs (*Chaceon albus*), Giant (King) crabs (*Pseudocarcinus gigas*) and Champagne (Spiny) crabs (*Hypothalassia acerba*)	Baited pots in waters lying north of latitude 34° 24' S (Cape Leeuwin) and west of the Northern Territory border on the seaward side of the 150m isobath out to the extent of the Australian Fishing Zone, mostly in 500 to 800 m of water. Year round. 4 Vessels operated in 2019.

Notes:

Data for Commonwealth- managed fisheries was taken from 2021 Fisheries Status Reports where possible.

Data for State managed fisheries was taken from the most recent Fisheries Status Reports or where available, catch data was requested from DPRID for the last 5 years (2016-2021) in a 10x10nM reporting grid (block 201161) in which the operational area sits. Some fisheries such as the PDSF (non-trawl sectors) only report against the larger 60 x 60nM grid in this area (block 20160) so the DPIRD FishCube data was also examined for this.

3.9.7 Summary of Values and Sensitivities of the Socio-Economic Environment within Operational Area and EMBA

Table 3-18 outlines those socioeconomic values that may be affected by routine events at the Stag Facility within the Operational Area as well as unplanned events that may arise within a potentially larger area (EMBA).

Table 3-18: Summary of Socio-economic values and sensitivities

Socio-economic value		Sensitivities within Operational Area	Sensitivities within EMBA
Commonwealth fisheries	North-West Slope Trawl	**No** – Not within Operational Area, restricted to depths >200 m	**Yes** – Limited effort within EMBA seaward of 200 m isobaths. Oil could disrupt fishing activity and potentially contact eggs and larvae of target species although no direct contact with target species.
	Western Deepwater Trawl Fishery	**No** – Not within Operational Area, restricted to depths >200 m and south of Operational Area	**Yes** – Limited effort within EMBA seaward of 200 m isobaths, unlikely that area of EMBA would be fished. Oil could disrupt fishing activity and potentially contact eggs and larvae of target species although no direct contact with target species.
	Western Skipjack	**No** - No effort on the NWS	**No** - No effort on the NWS
	Western Tuna and Billfish	**No** - No effort on the NWS	**No** - No effort on the NWS
	Southern Bluefin Tuna	**No** - No effort on the NWS	**No** - No effort on the NWS
State fisheries	Onslow Prawn Managed Fishery	**No -** Effort within coastal areas	**Yes** – oil may reach shallow coastal waters and shorelines (most likely in Area 3 of fishery) affecting fishery habitat and fishing activity
	Nickol Bay Prawn Managed Fishery	**No -** Effort within coastal areas	**Yes** – oil may reach shallow coastal waters and shorelines affecting fishery habitat and fishing activity
	Broome Prawn Managed Fishery	**No -** Effort within coastal areas	**Yes** – oil may reach shallow coastal waters and shorelines affecting fishery habitat and fishing activity
	The Kimberley Gillnet and Barramundi Managed Fishery	**No -** Effort within coastal areas	**Yes** – oil may reach shallow coastal waters and shorelines affecting fishery habitat and fishing activity
	Northern Demersal Scalefish Managed Fishery	**No –** No overlap with fishing zones	**Yes** – Oil may enter Area 1 and 2 of the fishery. Oil may interact with demersal fish, eggs and larvae within the plankton assemblage. Oil may interfere with fishing activities.

	Mackerel Managed Fishery	**Yes** - Area 2 overlaps Operational Area but interaction unlikely as fishery targets coastal reefs and headlands <40 m and 500 m restricted zone exists around Stag Facility.	**Yes** – Areas 1, 2 and 3 may be impacted by oil. Adult fish unlikely to be impacted due to depth of their habitat but eggs and larvae within plankton assemblage and shallow coastal juvenile fish habitat may be contacted by oil.
	Pilbara Demersal Scalefish Fishery (Line, Trap and Trawl)	**Yes** – Trap fishing zone only overlaps Operational Area but interaction unlikely as fishery targets reef areas (no reef areas exist near Operational Area) and 500 m restricted zone exists around Stag Facility.	**Yes** – Trawl, Trap and Line fishing activities may be disrupted by an oil spill. Adult demersal fish unlikely to be impacted due to depth of their habitat but eggs and larvae within plankton assemblage and shallow coastal juvenile fish habitat may be contacted by oil.
	Pearl Oyster Managed Fishery	**No** – Zone 1 overlaps Operational Area but collection of pearl oysters is performed by diving and Operational Area is beyond dive-able depths for the fishery. A 500 m restricted zone also exists around Stag Facility.	**Yes** – Fishing activity in Zones 1, 2 and 3 could be disrupted by an oil spill. Shallow water habitats and pearls could be directly impacted by oil but most likely would remain underneath floating oil.
	WA North Coast Shark Fishery	**No** – Shark fishery closed in vicinity of the Operational Area	**No** – fishery has been closed since 2009.
	Pilbara Developing Crab Fishery.	**No** – Fishing occurs in coastal waters inshore of the Operational Area	**Yes** - Fishing activity between Onslow and Port Hedland could be disrupted by an oil spill and oil could contact the shallow coastal habitats used by blue swimmer crabs.
	Exmouth Gulf Prawn Fishery	**No –** Fishing occurs within Exmouth Gulf only	**Yes** – EMBA boundaries indicate small degree of overlap only possible with the fishery. Fishing activity could be disrupted by an oil spill and oil could contact prawn eggs and larvae in upper water column.
	Gascoyne Demersal Scale Fishery	**No** – Restricted to Gascoyne waters and so permitted fishery management area does not overlap operational area.	**Yes** – EMBA boundaries indicate small degree of overlap possible with the fishery. Fishing activity could be disrupted by an oil spill and oil could contact demersal fish eggs and larvae in upper water column although no direct contact with target species.
	West Coast Rock Lobster Fishery	**No** – Restricted south of North-West Cape	**Yes** – EMBA boundaries indicate small degree of overlap possible with the fishery if fishing occurs off Ningaloo coastline. Fishing activity could be disrupted by an oil spill and oil could contact lobster eggs and larvae in upper water column although benthic juveniles and adults are unlikely to be contacted.

	Beche-de-mer Managed Fishery	**No** – Restricted to shallow diveable depths or wading depths	**Yes -** Fishing activity between could be disrupted by an oil spill and oil could contact the shallow coastal habitats used by beche-de-mer, marine aquarium fish and specimen shell species.
	Marine Aquarium Fish Managed Fishery		
	Specimen Shell Fishery		
	West Coast Deep Sea Crustacean Managed Fishery	**No** – Fishery extends from 150 m contour therefore no overlap with Operational Area.	**Yes** – Fishing activities may be disrupted by an oil spill. Adult crabs unlikely to be impacted due to depth of their habitat but eggs and larvae within plankton assemblage may be contacted by oil.
Recreational fishery		**No** – Usually closer to land	**Yes** - Fishing activities may be disrupted by an oil spill. Target species and habitat or target species may be directly impacted by oil. Eggs and larvae of target species within the plankton community may also be contacted by oil.
Aquaculture		**No -** None within Operational Area	**Yes** – Pearl farming occurs within the EMBA at Montebello Islands. Oil could interfere with the production process or impact on pearl oysters directly through reduced water quality.
Oil and Gas		**No -** None within Operational Area	**Yes** - oil and gas activities within the EMBA could be disrupted by an oil spill.
Shipping		**Yes** - No designated shipping route within operational area with nearest located ~ 5 km northwest, other vessels may wish to transit the area although shipping traffic excluded from the Operational Area	**Yes** - Shipping routes are located within the EMBA. Shipping activities could be disrupted by an oil spill.
Tourism		**No** - None within operational area.	**Yes** - Tourist activities within coastal areas of EMBA could be disrupted and long term impact to tourism could occur if tourist areas (e.g. coral reefs, beaches) are impacted by oil.
Cultural Heritage		**No** - None within or near the Operational Area	**Yes** –oil entrained oil could potentially contact the subsea *Tryal* shipwreck at Trial Rocks NW of the Montebello islands

4. CONSULTATION OF RELEVANT PERSONS

In the course of preparing the EP, Jadestone is required to consult with the persons specified in the OPGGS(E) 2009 Regulations.

Jadestone has developed and followed a “Stakeholder Engagement Process for Regulatory Approvals” to assist in consistently engaging with Relevant Persons across its approvals. This provides a strategic and systematic approach to Relevant Person consultation aiming to foster an environment where ongoing, open dialogue and two-way communication is undertaken to build positive relationships. This approach is in line with the International Association for Public Participation (IAP2) spectrum. The process followed is summarised in Figure 4-1.

Stag is an existing facility that has been in operation since 1998. The previous operator had a Consultation Strategy that incorporated updates to relevant persons of Stag related activities. As a result, relevant persons identified for Stag have been informed and consulted on a regular basis for some time.

Relevant persons were originally identified and classified according to criteria outlined in the consultation plan based on their interest/ activity/ function for the operations activity in 2016. A review of the originally identified and classified relevant persons was undertaken in June 2020 when the operational activity in the permit was planned to change from having a floating storage and offtake vessel in field, to a third-party tanker. Relevant persons were again identified as part of previous drilling scopes. A review of these relevant persons has been undertaken. With the focus of consultation now centring on those interested or affected by planned activities the classification scheme previously used to distinguish between relevant persons in the EMBA who may have not had as strong an interest is no longer being applied in this EP.

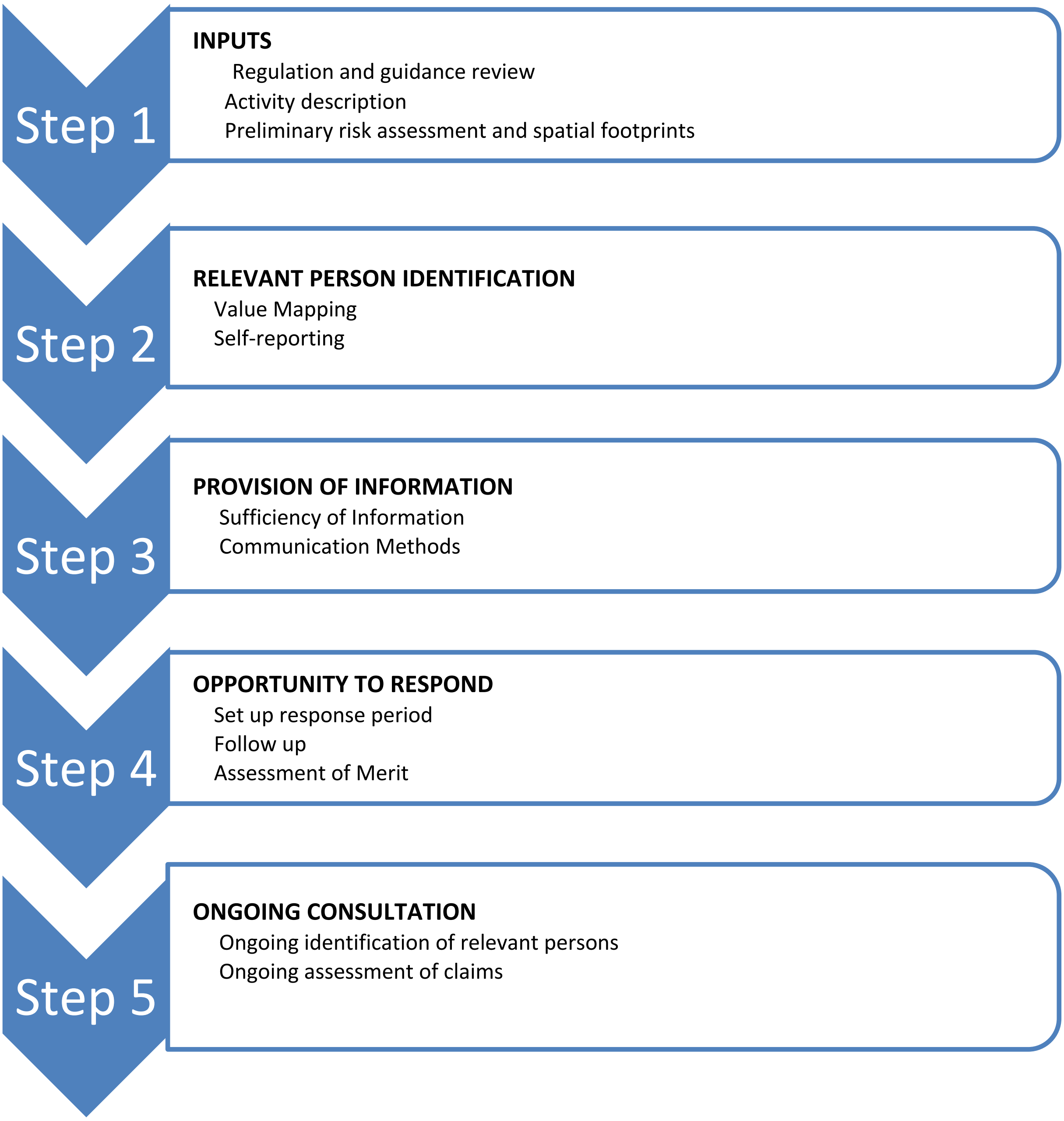

Figure 4-1: Summary of the Jadestone Relevant Person Engagement process

4.1 Fulfilment of Regulatory Requirements

The *OPGGS(E) Regulations 2009* stipulate several requirements in relation to consultation associated with an EP (Table 4-1).

Table 4-1: Consultation Regulatory Requirements

Regulation	Description	Fulfilment
11A(1)	In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a relevant person): (a) each Department or agency of the	Section 4.2 of the EP outlines the process (as per Jadestone Stakeholder Engagement Process for Regulatory Approvals) that was used to identify relevant persons in each of the five

	Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; (b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; (c) the Department of the responsible State Minister, or the responsible Northern Territory Minister; (d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan, being limited to the conduct of the activity that is authorised under the environment plan and not extending to a hypothetical, remote or speculative consequence from an activity such as a major oil spill; (e) any other person or organisation that the titleholder considers relevant.	groups required under the regulations. A list of the relevant persons can be found in Table 4-3 of this EP. A log of engagement with each of the relevant persons identified is provided in the Sensitive Information Report (not published for privacy reasons).
11A(2)	For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person.	For key stakeholders (particularly government agencies) email and phone discussions between staff were undertaken on specific issues. In addition to this all stakeholders were provided with targeted information fact sheets (Appendix E).
11A(3)	The titleholder must allow a relevant person a reasonable period for consultation.	To every extent possible, Jadestone has allowed 30 days for relevant persons to review and respond to new information regarding the proposed activity. Refer to Section 4.3.2 for consideration of this period and the concurrence of the comment period with the Christmas break.
14(9)	The implementation strategy of the environment plan must provide for appropriate consultation with: (a) Relevant authorities of the Commonwealth, a State or Territory; and (b) Other relevant interested persons or organisations.	The implementation section (Section 8.1.4) includes notification and ongoing consultation triggers.
16(b)	A report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains: (a) A summary of each response made by a relevant person; (b) An assessment of the merits of any objections or claim about the adverse impact of each	a) A log of all engagement undertaken with relevant persons is provided in the NOPSEMA sensitive information report (not published for privacy reasons). b) An assessment of merits including Jadestone's response to all claims is provided in Table 4-5 of this EP.

	activity to which the environment plan relates; (c) A statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (d) A copy of the full text of any response by a relevant person.	c) Full text of correspondence can be found in the NOPSEMA sensitive information report (not published for privacy reasons).
27	Storage of records: ● Records must be stored in a way that makes retrieval reasonably practicable; ● Records must be kept for five years; and ● Records generated through preparation of the environment plan, demonstrating environmental performance, incidents, emissions and discharges, calibration and maintenance, and in relation to the implementation strategy arrangements must be kept.	The Jadestone Stakeholder Engagement Process stipulates internal requirements for the storage of records.

Jadestone also undertook a review of consultation guidance provided by relevant government agencies and industry bodies to ensure effective consultation; this is listed in Table 4-2.

Table 4-2: Consultation Guidance

Agency	Guidance	Requirements	Fulfilment
COMMONWEALTH			
NOPSEMA	Clarifying statutory requirements and good practice consultation (nopsema.gov.au)	This Bulletin describes NOPSEMA's regulatory interpretation of relevant persons, provides clarification on definitions and advice on public comment, community engagement and relevant persons consultation.	Jadestone has used the descriptions of relevant persons to provide information and structure our engagement.
	Consultation with agencies with responsibilities in the Commonwealth marine area (nopsema.gov.au)	This Guideline provides insight into determining which agencies may be considered relevant for the purposes of statutory consultation.	Jadestone has considered the identified agencies per the guide as part of relevant person identification.
AMSA	Offshore Petroleum Industry Advisory Notice	To assist offshore petroleum industry titleholders address their oil spill preparedness and response requirements.	Jadestone has used this guidance to guide the development of the OPEP.
Parks Australia - Director of National Parks (DNP)	Petroleum activities and Australian marine parks (nopsema.gov.au)	This guidance document outlines process for engaging with the DNP throughout all stages of petroleum activity. For the preparation of an EP this includes considerations prior to consultation, timing of consultation, what constitutes sufficient information, and expectations of ongoing consultation.	Jadestone has ensured that the consultation with DNP and the information included in the EP is in accordance with this guidance.

4.2 Relevant Persons Identification

Central to Jadestone's business is maintaining a positive and constructive relationship with a comprehensive group of stakeholders in the community, government, non-government, other business sectors and other users of the marine environment. Jadestone has targeted its EP engagement to those defined as a relevant person under the NOPSEMA guidance (*Clarifying Statutory Requirements and Good Practice Consultation* (A696998)).

Jadestone used standardised identification methods (in accordance with its Stakeholder Engagement Process for Regulatory Approvals) to compile a list of relevant persons across these categories.

To identify relevant persons, Jadestone utilised the largest spatial extent whereby persons may be affected by the planned operational activities (the Operational Area).

For each of the five groups of relevant persons identified in Regulation 11A (1) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, four pathways were used to identify contacts:

1. **Beneficial Use/Value Mapping:** This process involved listing the potential receptors (with a focus on socio-economic receptors) that may be affected by the proposed activity, then determining relevant persons that may have functions, interests or activities. This process is captured in Appendix E.
2. **Regulatory Review:** This process involved undertaking a review of Ministers of regulatory portfolios of relevance and for region.
3. **Benchmarking:** This process involved identifying persons through benchmarking with other similar in-house or external projects, including cross referencing the stakeholder identification process for this EP with a review of the consultation undertaken for Montara Drilling and Operational activity EP.
4. **Self-reporting:** This process made available and encouraged opportunities for self-reporting, including the provision of contact details on Jadestone's website and information sheets.

Relevant persons identified for the activity, are listed and assessed in Table 4-3. A detailed description of the assessment underpinning this process can be found in (Appendix E).

Table 4-3: Assessment of Relevance of Identified Stakeholders

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
Commonwealth government departments/ agencies		
Australian Hydrographic Office (AHO)	Considered relevant persons under Regulation 11A(1) (a)	AHO is the part of the DoD responsible for publication and distribution of nautical charts, including Notice to Mariners. The Operational Area is in Commonwealth waters.
Australian Fisheries Management Authority (AFMA)	Considered relevant persons under Regulation 11A(1) (a)	AFMA is responsible for the management of Commonwealth fisheries. The Operational Area is in commonwealth waters. AFMA guidance is to engage through representative bodies and individual licence holders but will still keep them informed.
Australian Maritime Safety Authority (AMSA)	Considered relevant persons under Regulation 11A(1) (a)	AMSA is the statutory and control authority for maritime safety and vessel emergencies in Commonwealth Waters. The Operational Area is in commonwealth waters.

Department of Agriculture, Water and the Environment – Biosecurity and Compliance	Considered relevant persons under Regulation 11A(1) (a)	DAWE (marine pests) has primary policy and regulatory responsibility for managing biosecurity for incoming goods and vessels, including biosecurity for marine pests. The Department is a relevant agency when an offshore activity has the potential to transfer marine pests. The Operational Area is in Commonwealth waters.
Department of Agriculture, Water and the Environment – Fisheries, Forestry and Engagement (Fisheries)	Considered relevant persons under Regulation 11A(1) (a)	The activity has the potential to impact fishing operations and/or fishing habitats in Commonwealth waters.
Director of National Parks (DNP)	Considered relevant persons under Regulation 11A(1) (a)	The DNP is the statutory authority responsible for administering, managing and controlling Commonwealth marine reserves (CMRs). The Operational Area does not intersect any Australian Marine Parks. Notified as a RP due to potential spill impacts.
Department of Industry, Science, Energy and Resources	Considered relevant persons under Regulation 11A(1) (a)	Responsible for consolidating the Government's efforts to drive economic growth and job creation, productivity and competitiveness by bringing together industry, energy, resources and science.
State Government Agencies – WA		
Western Australian Department of Mines, Industry Regulation and Safety	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for state industry safety and regulation. Notified as a RP due to potential spill impacts.
Department of Transport	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for maritime transport.
Department of Primary Industries and Regional Development (Fisheries)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for fisheries management including biosecurity
Commonwealth fisheries		
Commonwealth Fisheries Association (CFA)	Considered relevant persons under Regulation 11A(1) (d)	Peak representative group for Commonwealth fisheries. The Operational Area is in commonwealth waters.
Australian Southern Bluefin Tuna Industry Alliance (ASBTIA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Bluefin Tuna fishery.
Australian Fisheries Trade Association	Considered relevant persons under Regulation 11A(1) (d)	Peak body representing Australia's recreational fishing industry.
State fisheries (WA) ***(based on fishing history in block 201161 – refer to Appendix E for full***		

fisheries assessment)		
WAFIC	Considered relevant persons under Regulation 11A(1) (d)	Primary representative body for WA fisheries.
Onslow Prawn Managed Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	Open fishing area overlaps with Operational Area. No effort in 10x10nM block. Notified due to historical catch history prior to the last 5 years, ability to fish in the area and involvement in previous consultation processes.
Mackerel Managed Fishery (Area 2) (WA)	Considered relevant persons under Regulation 11A(1) (d)	Area 2 (Pilbara) fishing area overlaps with Operational Area. Catch history in 10x10nM fishing catch block in last 5 years. Individual license holders consulted directly as catch history in last 5 years in grid of activity.
Pilbara Trap Managed Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	Open fishing area overlaps with Operational Area. Individual license holders consulted directly. Notified due to historical catch history prior to the last 5 years, ability to fish in the area and involvement in previous consultation processes.
Pilbara Line Managed Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	Open fishing area overlaps with Operational Area. Notified due to historical catch history prior to the last 5 years, ability to fish in the area and involvement in previous consultation processes.
Octopus Development Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	New Exemption Fishery, 6 Exemptions issued over Onslow Prawn Managed Fishery. They can only fish out of Onslow Prawn season.
Pearl Producers Association	Considered relevant persons under Regulation 11A(1) (d)	Representative body for pearl license holders PPA asked to be kept up to date on any activities through peak body.
Tourism operators/Charter fishing	Considered relevant persons under Regulation 11A(1) (d)	Low catch history in 10x10nM fishing catch block in last 5 years.
Marine Tourism WA (MTWA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for charter boat operators
Oil and Gas		
Australian Petroleum Production and Exploration Association (APPEA)	Considered relevant persons under Regulation 11A(1) (d)	Oil and gas industry representative body
Australian Marine Oil Spill Centre (AMOSC)	Considered relevant persons under Regulation 11A(1) (d)	Industry-wide response organisation providing services for training and response to a threatened or actual spill (unplanned

		event).
Conservation and Research		
Australian Institute of Marine Science	Considered relevant persons under Regulation 11A(1) (d)	Organisation concerned with conservation and research outcomes in the area.
CSIRO	Considered relevant persons under Regulation 11A(1) (d)	Organisation undertaking marine conservation research in the area
Western Australian Marine Science Institute	Considered relevant persons under Regulation 11A(1) (d)	Organisation undertaking marine conservation research in the area
Recreation		
Recfishwest	Considered relevant persons under Regulation 11A(1) (d)	Representative body for recreational fishing in WA
King Bay Game Fishing Club and Nickol Bay Sportfishing Club	Considered relevant persons under Regulation 11A(1) (d)	Recreational fishing clubs in the area
Others		
Hon Keith Pitt MP - Minister for Resources and Water	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder
Hon. William (Bill) Joseph Johnston MLA - Minister for Mines and Petroleum; Energy; Corrective Services	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder
Hon Angus Taylor MP - Minister for Industry, Energy and Emissions Reduction	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder
Hon Amber-Jade Sanderson MLA - Minister for Environment; Climate Action; Commerce	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder

4.3 Engagement Process

The engagement process adopted by Jadestone is in line with the International Association for Public Participation (IAP2) spectrum, which is considered best practice for stakeholder engagement.

Engagement was undertaken concurrently for this EP and Stag Operations 5 Year Revision Environment Plan (a separate EP). The information provided to relevant persons clearly delineated the scope and risks associated with each activity. It was decided to undertake concurrently to reduce stakeholder fatigue and avoid confusion of two engagement processes in such a close timeframe.

The Oil Pollution Emergency Plan (OPEP) includes Jadestone's emergency response plans. Pursuant to the environment regulations, state and federal government departments and agencies have been, and will continue to be, consulted on response preparedness for an uncontrolled discharge of oil from vessels or the well. All consultation associated with a spill response is outlined in the OPEP.

4.3.1 Sufficiency of Information

Jadestone is committed to ensuring adequate and open information with relevant persons and its investors as detailed in Table 4-4.

Table 4-4: Information provided to relevant persons

Format	Description
Information sheets	Two information sheets (One specific to fisheries and a general information) were used to support this EP were developed with sub-regulation 11A(2) and associated guidance in mind to ensure it adequately described the activity – including the risks associated with the activities. Copies of all information sheets provided can be found in Appendix E.
Individual Responses	Jadestone provided written responses to all written enquires received from stakeholders to address their specific concerns throughout the duration of EP development. A separate sensitive information report submitted to NOPSEMA contains all individual responses provided to stakeholders as part of this process.
Email and Telephone	Email and telephone were used to consult with relevant persons as part of the development of the EP. The sensitive information report contains all individual email records captured as part of relevant person consultation.

4.3.2 Reasonable period

Jadestone commenced consultation with relevant persons on 2 December 2021 with a general notification to all relevant persons. Relevant persons were encouraged to provide comment within a 25-day period from receipt of any update or information (by 27 December 2021).

Stakeholders are already aware and well informed of activity in this area. Given that works are within the existing restricted zone and to reduce stakeholder fatigue consultation for both the Stag Operations 5 Year Revision and Drilling EP were issued concurrently. Jadestone recognise that due to the Christmas break a specific response to this consultation package may not have been received by 27 December 2021. To allow stakeholders ample opportunity to provide feedback they were followed up in the first week of January 2022 to ensure the consultation package was not missed and asked to provide feedback by 14 January 2022.

Comments provided outside of this time will still be considered and incorporated into the approvals process. The criteria used to determine if engagement was sufficient and no more follow up is required includes:

- If no response was received following this period from a relevant person it will be followed up via email or telephone (with the exception of fishing licence holders where only postal details were available) and if no further response is received, then it is considered that no comment is to be provided and it is closed out; and
- If a response is received from any relevant stakeholder, it is assessed for merit and then a response provided to the relevant person.

This is subsequently assessed as:

- The relevant person acknowledges Jadestone's response and they were satisfied with the way their concerns had been addressed; or
- The relevant person is not satisfied with how the comments were addressed but were made aware of how their views were being reflected to NOPSEMA and how Jadestone was responding to them.

4.4 Assessment of Relevant Persons Objections and Claims

Prior to engaging with relevant persons, Jadestone reviewed the comments, objections and claims raised through the previous Stag Drilling and Operations EP's.

For all responses received by Jadestone during the engagement, the merit of each of these responses was assessed. For minor/administrative changes these are noted in the sensitive information report. Assessment of merit for all other responses is found in Table 4-5.

The Stakeholder Engagement Process for Regulatory Approvals process helped to guide the assessment of merit process.

Table 4-5: Assessment of Merit

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
Australian Maritime Safety Authority	Stakeholder Engagement ● To notify AMSA's Joint Rescue Coordination Centre (JRCC) (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing and at cessation of operations. ● Australian Hydrographic Office (datacentre@hydro.gov.au) to be contacted no less than 4 working weeks prior to operations commencing for the promulgation of related notices to mariners. ● To plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended operations.	Jadestone considers this comment has merit and has been actioned through changes to the EP.	● Item included in implementation section of EP (Table 8-1) to ensure notification 48 hrs prior to operations commencing and at cessation. ● Item included in implementation section of EP (Table 8-1) to ensure notification 4 working weeks prior to commencement. ● Item included in implementation section of EP (Table 8-1) to ensure notification to AHO and JRCC.
Australian Fisheries Management Authority (AFMA)	Unable to comment on individual proposals but noting resources for consultation with representative bodies or licence holders	Comment has merit and has been actioned.	In accordance with this guidance, as part of Jadestone's standard approach to consultation the representative bodies for Commonwealth fisheries have been engaged with during the development of the EP.
Australian Hydrographic Office (AHO)	Acknowledged and noted will be included in charting information.	Noted	No further action required.
Department Transport (DoT)	Comments received on Revision 0 of the OPEP in relation to: ● responsibility of response activities as defined in the State Hazard Plan – MEE ● Clarification on "no dispersant" zones ● Further details on the role of the Environmental & Scientific Coordinator for providing advice and dispersant testing details of a media plan or consultation and involvement of indigenous communities	Comment has merit and has been actioned through changes to the OPEP.	● DoT were issued Revision 0 of the OPEP upon submission to NOPSEMA. Responses to DoT comments have been incorporated into Revision 1 of the OPEP and a response to comment issued to DoT. A summary is provided below: ● Changes have been made throughout the OPEP, amending use of HMA to the SMPC where relevant. Section 5.3 of Appendix A7 has also been amended to reflect the role of the HMA versus the SMP

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
	• Arrangements for cost recovery		• Section 10.7 of the OPEP does provide criteria for where dispersant must not be applied. A new Section 10.9 has been added that provides guidance on use of dispersant in State Waters when DoT is required to provide consent. • In seeking the consent of the HMA/SMPC to use dispersants in State waters, the Incident Commander is expected to have had the option assessed by a panel formed within the IMT. This panel should be chaired by the Incident Controller and include the participation of the State Environmental Scientific Coordinator (ESC). The involvement of the CSIRO or other subject matter experts on the panel should also be considered. • Appendix A7, Section 9 of the OPEP outlines under Notifications and Media Strategy that the IMT Leader will work with the Media Team to ensure a media holding statement is prepared. • Deputy Public Information Officer's role has been updated to include (Table A7-9 of Appendix A7) - Advise on appropriate Aboriginal engagement and management strategies in the event of potential exposure of Aboriginal heritage sites, lands or waters to hydrocarbon spills, or for the potential access of responders to Aboriginal heritage sites or land. • A 'Cost Recovery' section has been added to Appendix A7, Section 8.4 of the OPEP,

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
			and includes the following statement: As required under Section 571(2) of the OPGGS Act 2006, Jadestone has financial assurances in place to cover any costs, expenses and liabilities arising from carrying out its petroleum activities, including major oil spills. This includes costs incurred by relevant control agencies (e.g. DoT) and third-party spill response service provider.
Department of Mines (DMIRS)	Stakeholder Engagement ● To provide DMIRS (petroleum.environment@dmirs.wa.gov.au) with pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS upon completion of the activity ● Ensure the EP includes information about the reporting of environmental incidents that could potentially impact on any land or water in State jurisdiction, including that any notifications or reports are to be sent to petroleum.environment@dmirs.wa.gov.au.	Jadestone considers this comment has merit and has been actioned through changes to the EP.	● Item included in implementation section of EP (Table 8-1) to ensure notification to DMIRS on commencement and cessation of activity. ● Item included in Table 9-1‘Routine and incident reporting requirements’
Department of Primary Industry and Regional Development (Fisheries Branch)	Stakeholder Engagement Suggested changes/ additions to current mitigation and management measures for IMS: • changing the wording from “if required” to “as req uired” • Notification of potential detection of IMS in WA w aters is made to DPIRD within 24 via Fishwatch (p h 1800 815 507) or by email to Aquatic.Biosecurit	Jadestone considers these comments to have merit and they have been addressed in the EP.	• ID41 in Section 7.1.3 of the EP states the following requirement for Environmental Performance: Management control: Vessels comply with Australian Ballast Water Management Requirements (DAWE 2020). Performance standard: All vessels discharging ballast water within the Operational Area are to maintain Ballast Water Records as per (DAWE 2000) requirements.

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
	y@dpird.wa.gov.au and will follow subsequent ad vice provided by Aquatic Biosecurity • Use the online tool Vessel Check to manage the bi osecurity risk for vessels entering WA waters https ://www.vessel-check.com		Measurement criteria: Ballast Management Plans and Ballast record books • DPIRD notification already included in Table 8.2. Email address has been updated throughout the EP • Jadestone has a Marine Biosecurity Manual (JS-70-MN-G-00001) which applies to vessels (including third party tanker at Stag Field) and mobile offshore drilling units (MODUs) under contract by Jadestone, and to all marine vessel operations in Jadestone Operational Areas with the exception of offtake tanker activities at Montara. This manual has also been inspected by NOPSEMA and deemed to meet EP requirements. All vessels engaged by Jadestone are to be subject to biofouling risk evaluation and management procedures in a manner consistent with Australian national (i.e. Commonwealth) policies and regulations, and relevant State and NT regulations, as applicable. The manual includes a comprehensive vessel risk assessment using tailored risk evaluation tools for international and domestic vessels and MODUs.
Director of National Parks (DNP)	Stakeholder Engagement • Confirmed no authorisation required as outside AMP • When preparing the EP avoiding impacts on migratory species should be considered such as the use of low power and shut down zones and timing of the activity – with particular attention to managing the risk to turtle foraging and internesting locations.	Jadestone considers these comments to have merit and they have been addressed in the EP.	• EP has been drafted to include information on the AMPs in Section 3.7.6. With no AMP in the operational area there is not expected to be any impact from planned activities on any AMPs. • EP has been drafted to include information on managing risk to turtle foraging and

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
	● When preparing the EP AMP values and representativeness should be considered and all impacts and risks to AMPs identified and shown to be managed to acceptable level and ALARP. Consistency with the management plans should also be included ● Confirmed DNP do not need any further notification on progress unless change of activity results in overlap with or new impact to a marine park or for emergency responses ● DNP should be made aware of oil/gas pollution incidences which occur with a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419293465. Notification should include: ○ Titleholder details ○ Time and location of the incident (including name of marine park likely to be effect) ○ Proposed response arrangement as per the Oil Pollution Emergency Plan ○ Confirmation of providing access to relevant monitoring and evaluation reports when available and ○ Contact details for the response coordinator		internesting, in particular in relation to light (Section 6.1), low power and shut down zones are not relevant to the drilling activity (applicable to seismic or VSP surveys only). ● Triggered consultation item included to notify AMP DG if any change to planned activity that results in change in risk to AMP (Table 8-2). ● Notification of DNP in the event of an oil or gas pollution incident has been included in Table 8-2 of the EP. ● EP has been drafted to include information on the AMPs in Section 3.7.6. With no AMP in the operational area there is not expected to be any impact from planned activities on the AMP.
Department of Water and Environmental Regulation (DWER)	No comments on the activity	Noted	No action required
Recfishwest	● Suggested Jadestone contact the two main fishing clubs in Karratha ● Would like to be updated on the project going forward	Jadestone considers these comments to have merit and they have been addressed in the EP.	● King Bay Game Fishing Club and Nickol Bay Sportsfishing Club have both been contacted and Jadestone are awaiting response. ● Item included in implementation section of

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
			EP (Table 8-1) to ensure notification to Recfishwest on commencement and cessation of activity.
Western Australian Fishing Industry Council (WAFIC)	WAFIC asked for information on the following: • Baseline scientific data on aquatic organisms and the aquatic environment • Detailed post spill scientific monitoring of aquatic organism and aquatic environment • Communication strategy that considers the commercial fishing industry in the event of a spill event • Support to the commercial fishing industry with regards to traceability of fish products to manage tainting risks, if required. • Financial assistance to the commercial fishing industry in the event of a spill event.	Comment has merit and has been actioned	Response was issued to WAFIC on 18 January 2022. Summary of responses below, no changes have been made to the EP or OPEP: • **Baseline scientific data on aquatic organisms and the aquatic environment** There are a number of existing baseline data sources that Jadestone uses including Industry-Government Environmental Metadata System (I-GEMS), Australian Ocean Data Network (AODN), Oil Spill Response Atlas (OSRA) and The Atlas of Living Australia (ALA). • **Detailed post spill scientific monitoring of aquatic organism and aquatic environment** Jadestone has a comprehensive Framework for Scientific Monitoringthat includes post-spill monitoring of the following marine receptors: Water Quality, Sediment Quality, Intertidal Mudflats, Sandy Beaches and Rocky Shores, Mangroves, Benthic Habitats, Marine Fauna, Seafood Quality, Fisheries and Aquaculture, Fish and Invertebrates. • **Communication strategy that considers the commercial fishing industry in the event of a spill event** In the event of a spill, Jadestone has a defined process for conducting notifications to regulatory authorities and

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
			support organisations. Section 17.2 of the OPEP includes an initial action outlining this, and references Appendix A6 (Regulatory Notifications). Appendix A6 includes a requirement for Jadestone to contact AFMA and DPIRD (Fisheries) within 8 hours. From this notification, Jadestone will liaise with those agencies and contact the relevant active commercial fisheries. • **Support to the commercial fishing industry with regards to traceability of fish products to manage tainting risks, if required.** This is included in SMP 7 – Seafood Quality, Fisheries and Aquaculture. In the event of a significant hydrocarbon spill event that triggers scientific monitoring, the aim of SMP 7 is to identify potential health risks due to the presence of hydrocarbons in the flesh of targeted fish/ fisheries/ aquaculture species. • **Financial assistance to the commercial fishing industry in the event of a spill event** As required under Section 571(2) of the OPGGS Act, the titleholder must, at all times while the title is in force, maintain financial assurance sufficient to give the titleholder the capacity to meet costs, expenses and liabilities arising in connection with, or as a result of the carrying out of the petroleum activity.

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
			Further details on each of these bullet points is provided in email correspondence in the SIR.

4.5 Environmental Performance

Hazard		Stakeholder consultation		
Performance outcome		**Relevant persons are kept informed of activities**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
1	Consultation for Environmental Approvals procedure (JS-70-PR-I-00034)	Relevant persons identified according to current Regulatory requirements	Consultation records	General Manager
2		Relevant persons provided a minimum 4-week period to respond to proposed planned activities		
3		If there is a potential change in the risks or impacts to relevant persons due to planned activities relevant persons are to be consulted prior to the activity commencing		
4		Relevant persons provided information 4 weeks prior to commencement of activities to provide a specified timeframe and assets that will be present for the drilling activities including commercial fishing license holders		

5. EVALUATION OF ENVIRONMENTAL IMPACTS AND RISKS

As required by Regulation 13(5) of the Environment Regulations, this section of the EP provides an outline of Jadestone's methodological approach to evaluate impacts and risks due to an activity (Section 2), and the outcomes of the impact and risk assessment undertaken for the drilling activities (Section 5.6).

5.1 Assessment Methodology

The environmental impacts and risks associated with the proposed drilling activities within permit WA-15-L have been assessed using the Jadestone Impact and Risk Management Framework (JS-70-PR-F-00009) and methods consistent with HB 203:2012 and AS/NZS ISO 31000:2018.

Impact is evaluated in terms of the extent, duration, severity and certainty pertaining to the effect that will or may occur in the environment due to a planned or accidental event associated with the activity.

Risk is evaluated in terms of likelihood and consequence, where likelihood is defined as the probability or frequency of the event occurring, while consequence, like impact, is defined as the extent, duration, severity and certainty pertaining to the effect that will or may occur in the environment due to a planned or accidental event associated with the activity.

The assessment methodology provides a framework to demonstrate:

- That the identified impacts and risks are reduced to as low as reasonably practicable (ALARP) (Regulation 10A(b)); and
- The impacts and risks are acceptable (Regulation 10A(c)).

The impact and risk management process is shown in Figure 5-1.

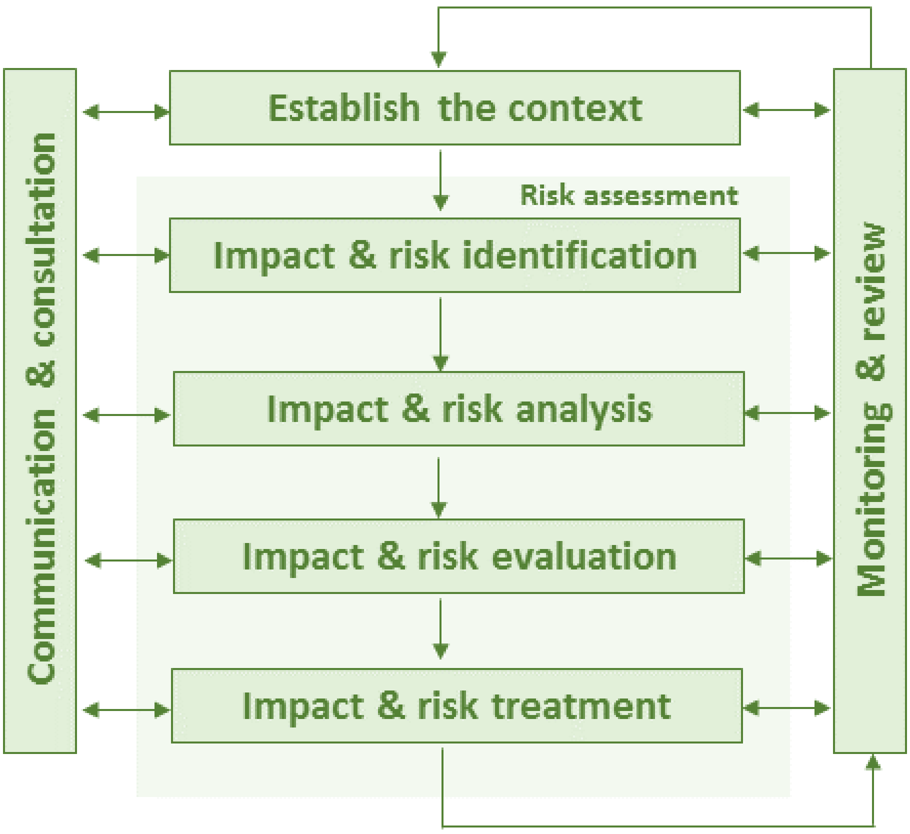

Image source: NOPSEMA (GN0165 Risk Assessment Rev 5, May 2017)

Figure 5-1: Impact and Risk Evaluation Process

Further detail on the steps involved in the impact and risk evaluation process is provided below.

5.2 Risk Assessment

The assessment process evaluates impacts and risks associated with planned and accidental events that will or have the potential to impact the environment. Impacts and risks are identified through a number of activities:

- Workshopping process attended by a team that includes relevant technical knowledge and experience in the activities being assessed;
- Information relating to previous environmental performance relevant to the activity being assessed such as findings of audits and inspections, incident investigations, performance reports;
- Feedback from relevant persons; and
- Industry related information of exploration and production activities relevant to the activity being assessed.

Analysis of the impacts and risks identified for the activity includes a number of steps intended to treat the impacts and risks to levels that are acceptable and as low as reasonably practicable for the business. The steps are:

- Identification of appropriate control measures (preventative and mitigative) to treat likelihood and consequence/ impact (below); and
- Determination of the residual impact/ risk ratings (Section 5.6).

5.2.1 Identification of control measures

The following framework tools are applied, as appropriate, to assist with identifying control measures:

- **Legislation, Codes and Standards** – identifies the requirements of legislation, codes and standards which are to be complied with for the activity;
- **Good Industry Practice** – identifies further engineering control standards and guidelines which 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 (see below), which is a system used in the industry to minimise or eliminate exposure to impacts or risks, is applied;
- **Risk Based Analysis** – 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 assessment process;
- **Company Values** – identifies values referenced in Jadestone’s HSE Policy; and
- **Societal Values** – identifies the views, concerns and perceptions of relevant persons and addresses their concerns as gathered through consultation.

In addition, Jadestone applies a hierarchy of control measures to help evaluate potential management controls to ensure reasonable and practicable solutions have not been overlooked:

- **Elimination –** it is preferable to remove the impact or risk altogether;
- **Substitution –** substitute the impact or risk for a lower one;

- **Engineering control measures** – use engineering solutions to prevent or detect the hazard or control the severity of consequences/ impacts;
- **Administrative control measures** – use of procedures, JHA etc. to assess and minimise the environmental impacts or risks of an activity; and
- **Protective** – use of protective equipment (e.g. the use of appropriate containers).

5.2.2 Risk ranking process

Risks are ranked using the Jadestone Qualitative Risk Matrix (Table 5-1). Environmental ranking of a measure between **Low** to **Extreme** is determined by evaluating the likelihood of the accidental event occurring, and evaluation of the expected severity of the consequence with standard expected control measures in place.

Table 5-1: Jadestone Qualitative Risk Matrix

Rating		Consequence				
		Negligible	Minor	Moderate	Major	Critical
Likelihood	Expected	Medium	Medium	High	Extreme	Extreme
	Probable	Medium	Medium	Medium	High	Extreme
	Likely	Low	Medium	Medium	Medium	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Medium	Medium

Consequence levels for accidental events are assigned on the basis of the expected extent of area that may be affected, the duration of effect and the severity of the effect. A consequence level of **Negligible** to **Critical** may be assigned (Table 5-2).

Table 5-2: Definition of Consequence Levels

Consequence	Consequence description	Socio-economic
5. Critical	Massive effect; recovery in decades; ecosystem collapse	Extensive damage International impact
4. Major	Major effect; recovery in 1 to 2 years; impact to population	Major damage National reputation impact
3. Moderate	Local effect; recovery in months to a year; impact to localised community	Local damage Considerable reputation impact
2. Minor	Minor effect; recovery in weeks to months; death of individuals	Minor damage Limited reputation impact
1. Negligible	Slight effect; recovery in days to weeks; injury to organism	Slight damage Slight reputation impact

Likelihood levels for accidental events are assigned on the basis of preceding performance in relation to the specific activity, within the region or in industry. A likelihood level of **Rare** to **Expected** maybe be assigned to accidental events (Table 5-3).

Table 5-3: Definition of Likelihood Levels

Likelihood	
5. Expected	Happens several times a month in similar exploration and production operations
4. Probable	Happens several times a year in similar exploration and production operations
3. Likely	Event has occurred in similar exploration and production operations
2. Unlikely	Heard of in the exploration and production industry
1. Rare	Never heard of in the exploration and production industry

Once assessed and treated, an assessment as to whether the risks recorded can be demonstrated as being acceptable and ALARP is made. The processes for determining if risks and impacts have been reduced to ALARP and acceptable levels are described below.

5.3 Impact Assessment

Environmental impacts that will occur as a result of planned activities may cover a wider range of issues, multiple species, persistence, reversibility, resilience, cumulative effects and variation in severity. The degree of impact and the corresponding level of acceptability is assessed against several guiding principles:

- Principles of ecologically sustainable development (ESD);
- Conservation and management advice;
- Stakeholder feedback;
- Reputational ramifications;
- Environmental context; and
- Jadestone's HSE Policy and Management System.

The application of the guiding principles within the acceptability matrix are outlined in Table 5-4.

The following process has been applied to demonstrate acceptability in the reduction of planned impacts:

- **GREEN** residual impacts are Tolerable, if they meet management requirements, stakeholder requirements, environmental context, and the Jadestone Energy HSE Policy and management system requirements; and
- **ORANGE** residual impacts are Intolerable and therefore unacceptable. Planned impacts with this rating will require further investigation and mitigation to reduce them to a lower and acceptable level. If after further investigation the impact remains in the unacceptable category, the impact requires appropriate business sign-off to accept the impact.

A reduction of impacts to as low as reasonably practicable (ALARP) follows the process described in Section 5.5.

5.4 Demonstration of Acceptability

An acceptable level of risk of an unplanned event occurring must be scored with a low or medium rating. Risks receiving a score of high (orange) or extreme (red) risk ratings in Table 5-4 are unacceptable. For those risks found to have an unacceptable rating, a return to the planning process for the activity is required to determine if an alternative approach to undertaking the activity can be identified.

Table 5-4: Jadestone Energy's acceptability matrix

Guiding principles		Impact level				
		1	2	3	4	5
A	Principles of ESD	Discharges/ emissions have slight effect – recovery in days to weeks	Discharges/ emissions have minor effect – recovery in weeks to months	Discharges/ emissions have local effect – recovery in months to a year	Discharges emissions have major effect – recovery in multiple years	Discharges emissions have catastrophic effect – recovery in decades
B	Conservation and management advice	Activity does not contact/ interact with sensitivities protected by conservation and management advice	Activity Triggered and adopts conservation and management advice of affected sensitivities	Activity must be modified to uphold conservation and management requirements of affected sensitivities	Activity as planned cannot uphold conservation and management requirements of affected sensitivities	Activity as planned will contravene conservation and management requirements of affected sensitivities
C	Stakeholders	No issues raised by stakeholders	Concern/ query received by stakeholders due to activity	Delay in commencement of activity due to stakeholder consultation	Modification of planned activity to achieve negotiated outcome	Executive involvement in resolving stakeholder concerns
D	Reputation	Slight impact – no media coverage	Limited impact – State media coverage	Considerable impact – national coverage	National impact – persistent national coverage	International impact – international coverage
E	Environmental context	Slight effect – recovery in days to weeks	Minor effect – recovery in weeks to months	Local effect – recovery in months to a year	Major effect – recovery in multiple years	Catastrophic effect – recovery in decades
F	Policy and Management System compliance	Proposed activity complies with JSE HSE Policy and Management System	Parts of the activity will not align with JSE HSE Policy and Management System	Proposed activity must be modified to align with JSE HSE Policy and Management System	Proposed activity cannot uphold intent of JSE HSE Policy and Management System	Proposed activity does not comply with JSE HSE Policy and Management System

5.5 Demonstration of ALARP

Regulation 10A(b) of the Environment Regulations requires a demonstration that risks are reduced to ALARP.

The ALARP principle states that it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principal arises from the fact that infinite time, effort and money could be spent attempting to reduce a risk to zero. An iterative evaluation process is employed until such time as any further reduction in the residual ranking is not reasonably practicable to implement. Following identification of the residual ranking, the ALARP principle is applied:

- Where the residual rank is **LOW** as:
  - Good industry practice or comparable standards have been applied to control the risk, because any further effort towards reduction is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.
- Where the residual rank is **MEDIUM**:
  - Good industry practice is applied for the situation or risk; and
  - Alternatives have been identified and the control measures selected to reduce the risks to ALARP. This may require assessment of Company and industry benchmarking, review of local and international codes and standards, consultation with stakeholders, etc. to demonstrate that alternatives have been considered, and reasons for rejection provided.
- Where the residual rank is **HIGH** or **EXTREME** the risk is not considered to be acceptable and the activity cannot continue as described. Further control measures must be applied such that an acceptable risk is demonstrated and the residual risk is reduced to 'Medium' or lower as described above. The activity should not be carried out if the residual risk remains 'High or Extreme'.

The process of evaluating the reduction of risks to ALARP is illustrated in Figure 5-2.

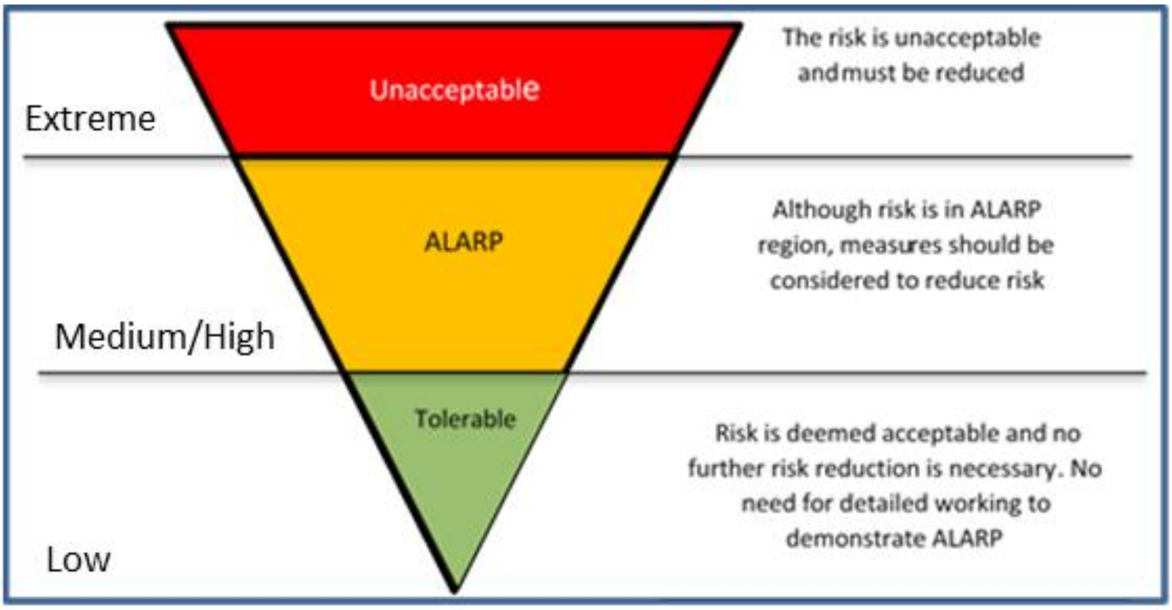

Figure 5-2: ALARP Triangle

5.6 Evaluation Summary

An impact and risk assessment workshop was conducted by Jadestone on the 8th of December 2021 to generate a register to reflect the Jadestone Impact and Risk Management Framework. The assessment was undertaken by a multidisciplinary team with sufficient breadth of knowledge, training and experience to reasonably assure that risks and impacts were identified and assessed. The assessment team included management, drilling, operations, and environmental personnel.

The assessment process undertaken by Jadestone in December 2021 for the proposed drilling activities within permit WA-15-L identified eight planned aspects and six unplanned hazards and their associated environmental impacts and risks that will or may occur during the activities.

The output of the assessment process is documented in the Stag Facility Drilling 50H and 51H ENVID Register and is summarised in Table 5-5; further detail underpinning the assessment record is provided in Sections 6 and 7.

Table 5-5: Summary of the environmental impact and risk assessment rankings for aspects and hazards associated with planned and unplanned events during the proposed drilling activities

Hazard	Residual Ranking
Planned activities	
1. Light emissions	Negligible
2. Noise emissions	Negligible
3. Atmospheric emissions	Negligible
4. Operational discharges	Negligible
5. Drilling discharges	Negligible
6. Physical disturbance	Negligible
7. Interaction with other users	Negligible
8. Spill response activities	Negligible

Unplanned activities	***Consequence***	***Likelihood***	***Residual Ranking***
1. Marine pest introduction	Moderate	Unlikely	Medium
2. Interaction with Fauna	Minor	Unlikely	Low
3. Unplanned release of solids	Minor	Unlikely	Low
4. Unplanned release of Non-hydrocarbon liquids	Minor	Unlikely	Low
5. Unplanned release of Stag Crude	Major	Unlikely	Medium
6. Unplanned release of Marine diesel	Minor	Unlikely	Low

5.7 Risk Assessment Approach for Worst-case Hydrocarbon Spill Response

The risk assessment approach for the worst-case hydrocarbon spill response requirements follows the risk assessment process as described above, with additional steps and considerations to determine an environmentally acceptable oil spill response strategy and an ALARP level of response preparedness:

1. Determine threshold concentrations to be used in oil spill modelling to define the RISK EMBAs as per NOPSEMA Bulletin #1;
2. Determine the environment that may be exposed (RISK EMBA);
3. Determine the environmental receptors that may be affected within the RISK EMBA as per Appendix B;
4. Identify sensitive receptors;
5. Determine priority receptors; and
6. ALARP and acceptability evaluation for spill response activities.

5.7.1 Determine Oil Spill Modelling Thresholds

Threshold concentrations for each of the hydrocarbon component types (floating oil, entrained oil and dissolved aromatic hydrocarbons (DAH)) are specified as inputs for the model to determine what potential exposure is recorded for each hydrocarbon type and the receptor/location, to ensure that potential exposure is assessed as per NOPSEMA Bulletin #1.

5.7.2 Determine the RISK EMBAs

The RISK EMBA for hydrocarbon concentration thresholds for the worst-case spill scenario for this EP is shown in Figure 7-2 and Appendix B). These contact concentrations are used to describe potential exposure to receptors at risk from the worst-case credible spill scenario. A description of the worst-case credible spill scenario resulting in the RISK EMBA is provided in Section 7.5.

5.7.3 Determine the impact threshold

Threshold concentrations for each of the hydrocarbon component types (shoreline accumulated oil, floating oil, entrained oil and DAH) are specified as inputs for the model to determine what contact is recorded for each hydrocarbon type and the receptor/location, to ensure that recorded contacts are assessed at environmentally meaningful concentrations. Meaningful concentrations are those concentrations at which environmental (or biological) impacts may occur, and at which societal values (e.g. visual aesthetics, economics) may be impacted.

The determination of environmentally meaningful impact thresholds is complex since the degree of impact will depend on the sensitivity of the value, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The chemical and physical properties of a hydrocarbon change over time due to weathering processes altering the composition. To ensure conservatism in defining the subsequent impact/risk assessment, the threshold concentrations applied to the model are based on the most sensitive environmental resources that may be exposed, the longest likely exposure times and on toxicity information for the hydrocarbon. Impact pathways and impact threshold concentrations are detailed in Appendix D.

5.7.4 Sensitive Receptor Identification

Jadestone Energy has generated spatial layers of known environmental and socio-economic values within the marine and coastal environment in WA State, Northern Territory, Commonwealth and adjacent international jurisdictions, to identify sensitive receptors (locations with highest environmental and/ or socio-economic values relative to other locations). The RISK EMBA is overlaid as a boundary to identify the sensitive receptors that exist within.

Sensitive receptor assessment considers:

- Protected Area Status: used as an indicator of the biodiversity values contained within that area e.g. World Heritage Areas, Ramsar sites and Marine Protected Areas;
- Biologically Important Areas (BIA) of Listed Threatened and Migratory Species: these are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, feeding, resting or migratory;
- Social values: socio-economic and heritage features (e.g. commercial fishing, recreational fishing, amenities and aquaculture);
- Economic values: recreational and commercial fishing areas;
- Listed species status and predominant habitats (surface versus subsurface): critically endangered/ endangered species, listed species, surface species (e.g. reptiles and birds) and subsurface species (e.g. mammals, sharks and fish); and

- Recovery Plans, Conservation Advice for threatened species.

Once the sensitive receptors within the RISK EMBA have been identified, the potential oil pollution risks are described and evaluated (refer Sections 7.5 and 7.6). In addition, the environmental risks from implementing spill response activities are described and evaluated.

Sensitive receptors are further evaluated by considering what values are contained within them when determining appropriate spill response strategies (refer Section 5.7.5). This informs the OPEP and guides spill response preparedness and planning.

The next step is to determine those sensitive receptors within the RISK EMBA that are considered the highest risk from the worst-case credible oil spill scenario and are common across ALL modelled scenarios and seasons, that is, the priority receptors.

5.7.5 Priority Receptors

It is important to note that in the event of a single worst-case hydrocarbon spill, not all sensitive receptors and areas within the RISK EMBA will be exposed or contacted at the same time or at all. Instead, the RISK EMBA is a collation of numerous possible scenarios (generally 100 or more) to develop the areas for focus in response preparedness and strategic planning. As such, only a portion would be contacted during a spill event.

It is best practice to develop spill response strategies for those areas most likely to be contacted in a single maximum credible worst-case spill. To be able to develop these strategies, the sensitive receptors in the RISK EMBA and their vulnerability to a hydrocarbon event (considering nature and scale of spill) need to be understood. A critical first step is to identify these areas – a concept termed here as ‘priority receptors’. The selection of priority receptors is based on stochastic modelling of multiple hydrocarbon spills.

Defining priority receptors determines the scale and needs of the oil spill response strategy. Thus, priority receptors (as a subset of all the sensitive receptors present within the full extent of the RISK EMBA) specific to a particular spill are selected using the following criteria:

- Sensitive receptor within RISK EMBA; AND
- >5% probability of shoreline contact based on modelling results; OR
- Has the largest volume of floating oil shoreline contact; OR
- Has the shortest timeframe to floating oil shoreline contact; OR
- Vulnerability to impact from hydrocarbons – e.g. mangroves are more vulnerable than intertidal rock pavement; known turtle nesting beaches are vulnerable during nesting periods[2]*;* AND
- Any other area of interest within the RISK EMBA including areas that have a high social value or are a concern raised through stakeholder consultation (refer Section 4).

It is logical and best practice to focus spill response planning and strategies on those locations most likely to be contacted in the credible worst-case oil spill scenario; that is, the scenario that represents the highest risk across all modelled scenarios covering any season, rather than attempt to cover the full spatial extent of the RISK EMBA. This allows for flexibility in response planning as plans are developed for environmental resources at greatest risk of being contacted by an oil spill and can be adapted for any scenario that occurs.

The evaluation of priority receptors is based upon stochastic modelling of multiple hydrocarbon spills. The focus for spill response planning and preparedness is based upon the level of risk (probability of contact, vulnerability to hydrocarbons, time to contact and volume/concentration of loading). Response Plans are based on the nature and scale of the worst-case modelled hydrocarbon event for each Protection Priority,

[2] IPIECA, the global oil and gas industry association for environmental and social issues, the International Maritime Organisation (IMO) and International Association of Oil and Gas Producers (OGP) developed a guidance document for ‘Sensitivity mapping for oil spill response’ IPIECA/IMO/OPG (2012). This document was used as a reference and basis for the sensitivity of habitats vulnerability assessment.

which includes estimation of shoreline loading volume and time to contact without consideration of response strategies interventions, which are provided in the OPEP.

For the purposes of spill response preparedness strategies, it is not necessary for all priority receptors to have specific operational response plans in place. For example, wholly submerged priority receptors may only be contacted by entrained oil, and the response will largely be the implementation of scientific monitoring to assess impact and recovery. Priority receptors with emergent features can have response actions prepared.

Jadestone's Framework for Scientific Monitoring (JS-70-PR-I-00038) was previously submitted as part of the Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan (TM-50-PLN-I-00004) approval which is publicly available on the NOPSEMA website. In accordance with Regulation 31 of the OPGGS(E)R, Jadestone refers to this information previously given rather than reattaching to this submission.

5.7.6 ALARP and Acceptability Evaluation for Spill Response

Jadestone applies a robust and systematic process to ensure that credible spill scenarios are adequately evaluated, to promote a clear link between the nature and scale and the Protection Priorities, and, to ensure that effective control measures exist to mitigate environmental risks and impacts to a level that is ALARP and acceptable. This process is depicted in Figure 5-3.

The process promotes a clear link between the nature and scale of the maximum credible worst-case spill scenario and the identified Protection Priorities to ensure that selected response strategies are appropriate and demonstrated to be effective and adequate.

As part of the risk assessment process, the spill response strategies selected are evaluated for their environmental impact (Figure 5-4).

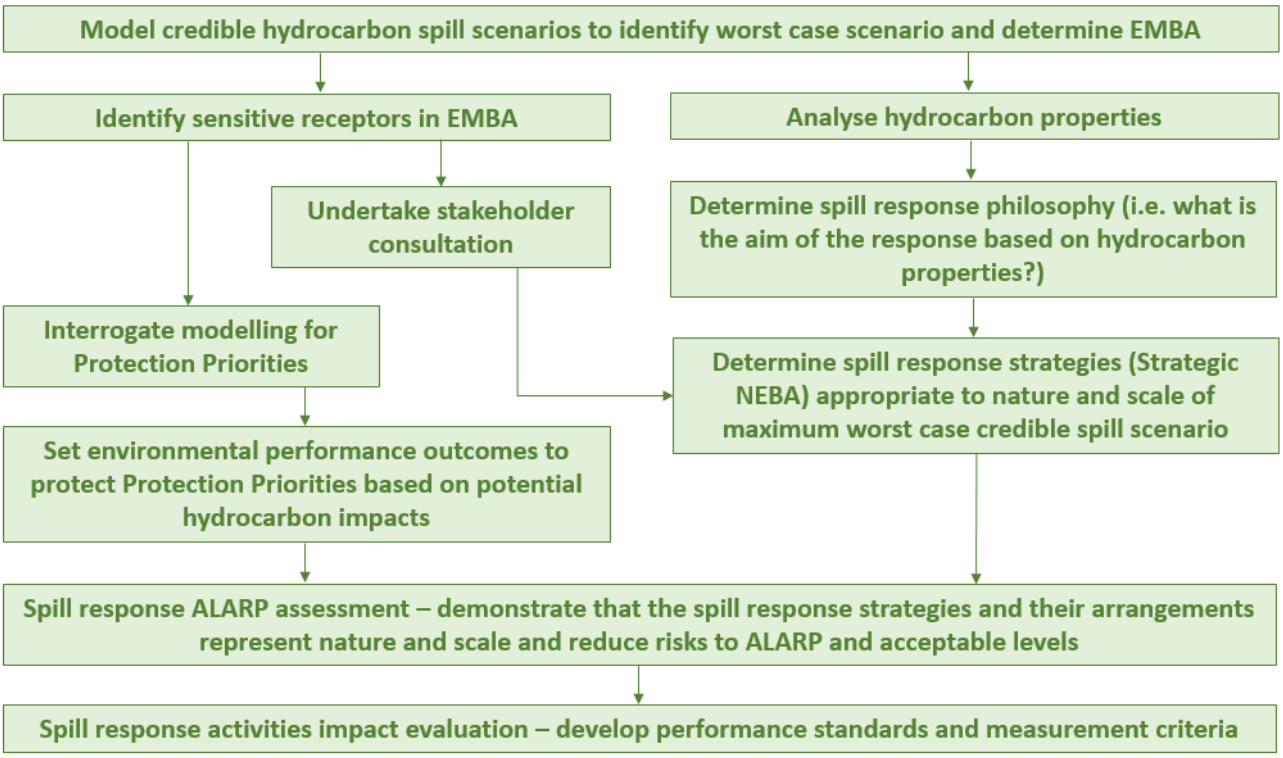

Figure 5-3: Spill Scenario Evaluation and ALARP Determination Process

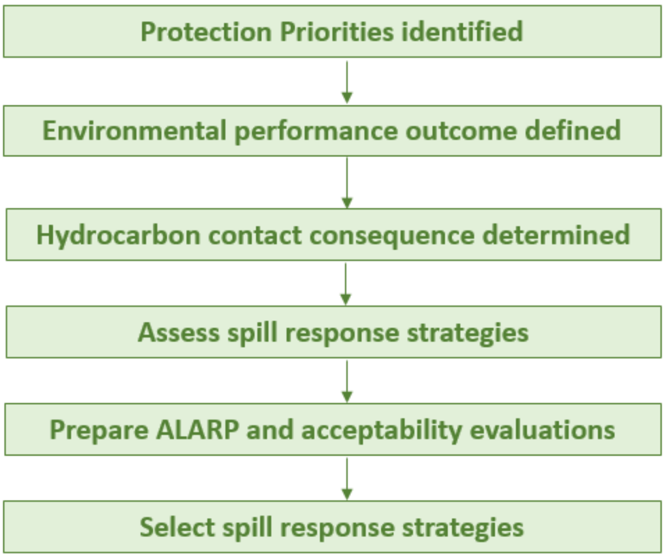

Figure 5-4: Spill Control Analysis and ALARP Determination Process

6. HAZARD ASSESSMENT – PLANNED ACTIVITIES

This section of the EP describes the environmental impacts that will occur due to planned activities associated with the proposed drilling activities within permit WA-15-L. In addition, mitigation and management measures that will be implemented to reduce impacts to an acceptable level are defined.

The impact assessment process identified nine environmental hazards associated with planned drilling activities. The residual consequence rankings for the hazards listed are summarised in Table 6-1 and presented in detail in this section.

Table 6-1: Summary of the Environmental Consequence Assessment Rankings for Hazards Associated with Planned Activities

Hazard	Residual Consequence Ranking
1. Light emissions	Negligible
2. Noise emissions	Negligible
3. Atmospheric emissions	Negligible
4. Operational discharges	Negligible
5. Drilling discharges	Negligible
6. Physical disturbance	Negligible
7. Interaction with other users	Negligible
8. Spill response activities	Negligible

The evaluation of impacts identified during the assessment process for each of the hazards associated with planned activities is presented as follows:

- Description of the hazard;
- Impacts – a discussion and assessment of the environmental impacts associated with the proposed activity;
- Environmental performance – a description of a measurable level of performance required for the management of environmental aspects to ensure that the environmental impacts will be of an acceptable level, and a statement of performance required of a control measure. This includes a description of the control measures in place to reduce the impacts; and
- Demonstration of ALARP and Acceptability – a demonstration that the environmental impacts will be reduced to ALARP and will be of an acceptable level, and the rationale for these statements.

6.1 Light Emissions

6.1.1 Description of Hazard

Aspect	Light emitted from the MODU and support vessels during 24 hour operations for a period of approximately 90 days at the Stag Facility. Navigational and safety lighting on the vessel will generate light emissions that may potentially affect marine fauna behaviour. Lighting typically consists of bright white (metal halide, halogen, fluorescent) lights attenuating with distance.

6.1.2 Impacts

Direct light spill on surface waters will be limited to the area directly adjacent to the MODU and support vessels within the Operational Area. For noting, the light generated by the MODU and support vessels will occur within the lighting footprint of the Stag CPF.

Depending on weather conditions, the MODU lighting will be visible at distances of tens of kilometres, with intensity attenuating with distance. Light from support vessels is visible over shorter distances since their lights are closer to the sea surface. In all cases (MODU and support vessels), lighting is not expected to illuminate any beaches with the closest being >30 km away (Dampier Archipelago).

Potential impacts to marine fauna from artificial lighting associated with the drilling activities are:

- Disorientation, attraction or repulsion; and
- Disruption to natural behavioural patterns and cycles.

These potential impacts are dependent on:

- Density and wavelength of the light emitted and the extent to which light spills into areas that are significant for breeding and foraging;
- Timing of overspill relative to breeding and foraging activity; and
- Resilience of the fauna populations that are affected.

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

A PMST Search was conducted on a 20km buffer around the defined operational area to identify any MNES species within the recommended 20km threshold that light impacts may occur. Only the Roseate tern was identified as potentially occurring within the 20km buffer and potentially affected by light emissions in addition to those species identified to occur within the defined operational area.

<u>Marine Turtles</u>

Turtles are known to use a variety of cues for navigation when in the water. However, light is not thought to be an important cue for adults, although adults are considered to have a preference for non-illuminated beaches (EPA 2010). The significant concern is to nesting beaches as identified in the Recovery Plan for Marine Turtles in Australia (DoEE 2017).

The National Light Pollution Guidelines states that a 20 km buffer (based on sky glow) to important habitat for turtles should be applied when considering possible impacts (DoEE, 2020). However, the demonstrated impacts on which this buffer is based were in response to light emissions associated with a liquified natural gas (LNG) plant. Although details around the individual light sources of the case study and the light sources on the vessels are unknown, it is expected that light emissions associated with vessels and MODU will be notably lower compared to an LNG plant. Given the operational area is located greater than 20 km away from the nearest turtle nesting beach, light emissions will not be visible. Experienced nesting females are unlikely to be disturbed by light, but first-time nesters may be disturbed by light when they are selecting their first nesting beach (Pendoley, 2014).

The Flatback turtle BIA (inter-nesting buffer) overlaps the operational area. Although there may be transient individuals most females inter-nest close to their nesting beaches, typically in shallow (0–10 m) nearshore waters within 5–60 km of the nesting beach (Chevron 2008). The drilling activities are in a water depth of approximately 49 m depth, and the nearest significant nesting beaches are 32 km away on Dampier Archipelago and the Montebello/ Barrow/ Lowendal Islands (75 km SW).

Adult turtles transiting through permit WA-15-L and the drilling locations therein, may temporarily alter their behaviour while attracted to the light spill from infrastructure. However, given that the nearest turtle nesting beaches and shallow water feeding habitats are at considerable distances away from lighting associated with the proposed drilling activities, lighting is not expected to have any impact on adult nesting turtles or feeding/ breeding aggregations. Furthermore, once in the water, turtle hatchlings orientate by wave fronts and do not appear to rely on visual cues (Pendoley, 2014), therefore light emissions should not cause disorientation at that distance (i.e., greater than 20 km). Foraging turtles are adults and not considered as significantly impacted by lighting as hatchlings (refer below).

Sea turtle hatchlings leaving nesting beaches disperse broadly as they navigate into oncoming waves, which draw them offshore into deep water. Once in the ocean, hatchlings are thought to remain close to the sea surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. Light, while an important cue on the beach, is not thought to be significant at sea where wave direction cues give way to magnetic orientation as the hatchlings move into deeper water (Witherington and Martin, 2003). During this period in the water however, light spill may influence hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon et al., 1992). The diffuse glow from light sources can cause disorientation to hatchlings up to 4.8 km from the light source (Limpus, 2006, in EPA, 2006). The locations of the proposed drilling activities are greater than 20 km from the turtle nesting beaches of the Montebello Islands and Dampier Archipelago and therefore negligible impact to marine turtle hatchlings is expected.

Seabirds

The light from the MODU and support vessels may provide enhanced capability for seabirds to forage at night (BHPB, 2005). Studies in the North Sea indicate that migratory birds are attracted to lights on offshore platforms when travelling within a radius of 3–5 km from the light source. Outside this area their migratory path will be unaffected (Marquenie et al., 2008).

According to the National Light Pollution Guidelines for Wildlife, a 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15 to 18 km from the light source and fledgling seabirds grounded in response to artificial light 15 km away. The intensity and extent of light glow, and the potential to result in biological impact, will be dependent upon the light source itself, including the number, intensity, spectral output and position of individual lights at the source. The effect of light glow may occur at distances greater than 20 km for some species and under certain environmental conditions (Commonwealth of Australia, 2020). The Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) identifies light as a threat and includes navigation aids, but also recognises that adult seabirds are less impacted than fledglings. The matrix identifies potential impacts to seabirds from light pollution as minor and recommends mitigation of light pollution around breeding colonies and from boats.

Given that only a small number of seabirds are likely to be affected by light spill from the drilling activities whilst in transit, any behavioural disturbances that may occur such as disorientation and attraction are expected to be minor and temporary. The breeding BIA of the EPBC migratory species – wedge tailed shearwater overlaps the Operational area and 20km buffer and the drilling activities therein. However, light emissions are not identified as a threat to the species (SPRAT Wedge-tailed shearwaters, DEE 2017as).

Plankton, Fish and sharks

The response of fish to light emissions varies according to species and habitat. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al. 2001). Lindquist et al. (2005) concluded from a study that artificial lighting resulted in an increased abundance of clupeids (herring and sardines) and engraulids (anchovies); these species are known to be highly photopositive. Shaw et al. (2002), in a similar light trap study, noted that juvenile tuna (Scombridae) and jack (Carangidae), which are highly predatory, may have been preying upon higher than usual concentrations of zooplankton that were attracted to a vessels light field.

There is a potential for individuals to be impacted by light emissions from lighting. However, as the Operational Area does not contain any significant feeding, breeding or aggregation BIAs for fish it is more likely there will be individuals traversing the area then large groups of species.

Light associated with the activity will affect a small portion of the vast biologically important foraging area for whale sharks. However, impacts at a population level are not expected due to the limited duration of the activities.

Cumulative Impacts from activities at the CPF and MODU

Cumulative impacts from lighting are not expected as the area of potential impact from lighting will be within the same area of impact from the CPF operations. When the MODU is adjacent to the CPF and vessels are servicing the MODU, the ambient light is not expected to be significantly greater than that provided by the CPF. Light intensity may be slightly increased compared to current lighting, but no significant cumulative impacts to fauna are expected from this.

Overall Consequence assessment: Negligible

6.1.3 Environmental Performance

Hazard		Light (EPH-01)		
Performance outcome		**Activity lighting managed in accordance with safety requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
5	Vessel and MODU navigation aids and equipment meet regulatory and safety requirements by aligning with Navigation Act 2012	Vessels will comply with maritime safety and navigation requirements including: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS); • Chapter V of Safety of Life at Sea (SOLAS); • Marine Order 21 (Safety of navigational and emergency procedures) (as appropriate to vessel class); • Marine Order 30 (Prevention of collisions) (as appropriate to vessel class) Vessels to maintain radio channels and other communication systems.	PMS confirms navigational equipment is maintained to regulatory and safety standards Records confirm that required navigation equipment is fitted to all vessels to ensure compliance with maritime safety and navigation requirements. Records confirm vessels maintain communication systems.	MODU OIM Vessel Master

6.1.4 ALARP Assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of light emissions to ALARP. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected Control	Hierarchy	Practicable	Cost Effective	Justification
All activities completed in daylight hours only	Eliminate	No	No	Daylight operations only considered to introduce unnecessary cost (i.e. 12 vs 24 hour ops.), whilst delivering little/ no environmental benefit. The operations cannot be shut down on a daily basis, and there would be a >100% increase in time taken to complete the activities resulting in doubling costs and extended duration to complete the activity. Light from the MODU and vessels will not illuminate beaches where receptors (including turtle hatchlings) sensitive to light emissions are present.
Replace external lights or reduce the lighting	Substitute	No	No	Lights are required to create illumination levels needed for safe working, emergencies and navigational requirements. No additional cost, but introduces unacceptable safety risks to personnel and vessels. Little benefit given relatively low numbers of turtles and seabirds in operational area and surrounding waters.
Add filters to lights or re-design placement/ positioning	Engineering	No	No	Lighting has been positioned such that maximum illumination of work surfaces within asset structures is achieved. Costly and considered grossly disproportionate to any gain when considering the distances that the Operational Area is from turtle or seabird nesting areas.
Reduce usage of lighting in peak sensitive receptor windows	Isolation	No	N/a	To ensure lighting meets health and safety requirements, lighting is required throughout the day/ night for the duration of the activities. To isolate usage such that lights were not used during sensitive receptor windows would create a non-conformance with health and safety requirements.
None identified	Administrative	N/a	Na/a	N/a

6.1.5 Acceptability Assessment

The potential impacts due to light emissions are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. No control measures are proposed as a reduction below maintenance of light levels in accordance with health and safety regulations.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from lighting on sensitive receptors.
Laws and standards	Lighting on the MODU has been designed to meet health and safety requirements. All vessels in Australian waters adhere to the navigation safety requirements contained within the Navigation Act 2012 and subordinate Marine Orders with respect to navigation and workplace safety equipment (including lighting). There are no standards for acceptable levels of lighting to seabirds or turtles.
Industry best practice	Lighting on the MODU and vessels is designed to be at minimum safe operational levels.
Environmental context	While there is direct light spill to sea surface immediately around the MODU and support vessels, the impact and risk assessment process indicates that the light spill will not cause significant behavioural effects to adult turtles and marine mammals that may transit the Operational Area. Light is identified in the National recovery plan for Turtles (2017) as a threat to turtles on nesting beaches only. Although the operational area overlaps an internesting BIA for flatback turtles, impacts to adults from lighting is not expected to significantly affect the adult turtle behaviour. There will be no light spill on nesting beaches. Light is also identified as a threat to seabirds in the Draft Wildlife Conservation Plan for Seabirds (CoA, 2019), however the operational area is not within 20 km of a breeding colony and lighting is essential for the activity (navigational lighting). Light is not identified as a threat to the wedge tailed shearwater of which a breeding BIA overlaps the Operational Area. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management / Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	Light is identified in the National recovery plan for Turtles (2017) as a threat to turtles on nesting beaches only. There will be no light spill on nesting beaches and therefore the activity is considered to be conducted in a manner that is consistent with the Recovery Plan and the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019). Light pollution is identified as a threat in the Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) and includes navigation aids. Though the plan does identify lighting from vessels as having potential impacts, the operational area is not in close proximity to any breeding areas and therefore only individuals overflying the location are considered likely and the impacts are considered negligible. No explicit controls are listed in the plan to manage lighting impacts.

	Jadestone has had regard to the representative values of the protected areas within the RISK EMBA, and the respective management plans and other published information. Impacts from light emissions will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.2 Noise Emissions

6.2.1 Description of hazard

Aspect	Noise is generated by the MODU, vessels and helicopters associated with the activity. Highest noise levels are likely to occur during supply boat operations, and MODU mobilisation/ demobilisation, during which vessels use thrusters to move into position. During drilling operations, it is intended that support vessels will hold station using thrusters, and the MODU will maintain station using legs as it will be a jack-up rig. No vertical seismic profiling or side scan sonar will be used during the activities.

MODU Operations

The frequency and level of noise received underwater from operating machinery will depend on a number of variables including the type of infrastructure; the types and sizes of engines; as well as the local hydro-acoustic and geo-acoustic environment.

A range of broadband values (59 to 185 dB re 1 µPa (ms SPL)) have been quoted for various MODUs (Oceans of noise, 2004), where noise is likely to be between 100 and 190 dB re 1 µPa (ms SPL) during drilling. McCauley (1998) reported noise levels generated by a semi-submersible rig, during non-drilling periods the typical broadband level encountered was approximately 113 dB (rms) re 1 µPa@125 m with various tones from the machinery observable in the noise spectra. There was a significant variation in the broadband noise during non-drilling periods, attributed to the operation of specific types of machinery. During periods the broadband noise level increased to the order of 177 dB (rms) re 1 µPa@125 m. Studies undertaken in the Arctic on different MODU types (including semi-submersible and drill ships) indicate that noise levels dropped to 117 dB re 1 µPa within 1 km of the MODU and are much lower than those for large commercial vessels operating at normal speeds (Austin et al., 2018).

In general, jack-up MODUs transmit less noise underwater than a semi-submersible platform or a drill vessel due to a smaller surface area being in contact with the water column. Jack-up MODUs have been measured to produce noise between 0.005 and 1.2 kHz during drilling activity with a source level of 59 dB re 1 µPa m (Simmonds et al., 2004). A 2001 underwater acoustic survey (Marine Acoustics, 2001) of a jack-up MODU operating in shallow waters (24.4 to 27.4 m water depth) reported non-continuous (less than one second) noise levels exceeding 120 dB re 1 µPa, were measured to a maximum range of 1.17 to 1.4 km from the MODU in a frequency band of 8.9 to 44.7 Hz. Underwater noise measured during this survey was at all times below 160 dB re 1 µPa.

Noise from MODU operations is expected to be low as all operating equipment including generators, engines and machinery is above sea level in the circumstance of a jack-up drilling rig. Therefore, noise received in the marine environment is expected to be at the lower end of the ranges described above.

Support Vessel Operations

The MODU will be assisted by approximately three support vessels. Studies of the radiating underwater noise generated from the propellers of support vessels when holding position ('DP') indicate highest measured levels of up to 182 dB re 1Pa with levels of 120 dB re 1Pa measured at 3–4 km (McCauley, 1998). McCauley (1998) also measured underwater sound levels from the Pacific Ariki, a 64 m long support vessel with 8000 HP (6,000 kW) main engines during calm conditions in the Timor Sea in 110 m of water while transiting at 11 knots, and found the distance to 120 dB re 1 µPa to be approximately 1 km.

For the benefit of comparison, a DP MODU will typically produce low intensity but continuous sound while holding station, emitting noise levels between 85 and 135 dB re 1 µPa (ms SPL) when not actively drilling (i.e. noise levels just due to thrusters), while the median sound level measured across five FSOs on the NWS was recorded at 181 dB re 1 µPa (Erbe et al., 2013).

Under normal operating conditions when vessels are idling or moving between sites, support vessel noise would be detectable only over a short distance (tens of metres). When a support vessel is using main engines and thrusters to hold position, the noise may be detectable above background noise levels for hundreds of metres or more during calm weather conditions, although this range of audibility will be reduced under noisier (windier) background conditions (BHPB, 2005).

Helicopter Operations

The extent of helicopter noise impacts are limited to take off and landing at the MODU as they do not fly close to the ocean surface (with a typical cruising height of between approximately 1,000 to 1,400 m) except to undertake these tasks.

The main acoustic source associated with helicopters is the impulsive noise from the main rotor and high-speed impulsive noise related to trans-sonic effects on the advancing blade. Dominant tones in noise spectra from helicopters and fixed wing aircraft are generally below 500 Hz (McCauley, 1994). Other tones associated with the main and tail rotors and other engine noise can result in a larger number of tones at various frequencies (BHPB, 2005).

Sound traveling from a source in the air (e.g., a helicopter) to a receiver underwater is affected by both in-air and underwater propagation processes, which are further complicated by processes occurring at the air seawater surface interface (e.g., wind and waves). The level of noise received underwater depends on source altitude and lateral distance, receiver depth, water depth, and other variables.

Helicopter engine noise is emitted at various frequencies however, the dominant tones are generally of a low frequency below 500 Hz (Richardson et al., 1995). Sound pressure in the water directly below a helicopter is greatest at the surface and diminishes with increasing receiver depth. Noise also reduces with increasing helicopter altitude, but the duration of audibility often increases with increasing altitude, with sound penetrating water at angles less than 13°. The noise from the flyover of a Bell 214 helicopter (stated to be a noisy model) has been recorded underwater (Richardson et al., 1995). The sound source was 162 dB re 1 µPa @ 1 m at its peak and had frequency of 155 Hz.

6.2.2 Impacts

The nature and scale of impacts from noise emissions generated during this activity must be considered in the context of the ambient noise environment. Ambient underwater noise levels are dependent on location, and are often dominated by local wind noise, waves, biological noise and ship traffic. Wind speed and seabed conditions have a clear influence on the ambient noise level. Existing anthropogenic underwater noise sources in the region of the drilling activity include shipping, small vessel traffic servicing the Stag CPF and other nearby operators, as well as the overarching operations that are ongoing at the Stag CPF.

The response of marine fauna when exposed to underwater noise from anthropogenic sources is dependent on a number of factors, including distance from the sound source, water depth and bathymetry, the animal's hearing sensitivity, type and duration of sound exposure and the animal's activity at time of exposure. Potential impacts to marine fauna due to noise and vibration in the underwater environment may occur, and can result in a range of responses including (Richardson *et a*l., 1995; Southall *et a*l., 2007):

- Injury to hearing or other organs: hearing loss may be temporary (temporary threshold shift (TTS)) from which an animal recovers within minutes or hours, or permanent (permanent threshold shift (PTS)) from which the animal does not recover;
- Masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey); and
- Disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation. This includes attraction to the noise sources as well as avoidance.

Criteria have been derived from a number of sources to determine the potential for behavioural and physiological impacts to sensitive receptors. These thresholds have been compared with measured and predicted sound levels for various sound sources expected during the activity to determine the potential impacts. For the proposed activity only non-impulsive sound sources have been considered due to the nature of the activity. No impulsive sound sources (for example vertical seismic profiling) have been identified.

EPBC Act listed and threatened migratory species that may be present near the activities include whales migrating through the Operational Area, whale sharks and turtles. Noise is identified as a threat within the conservation advice or recovery plans (refer Table 3-3) for a number of the EPBC species that may occur in the Operational Area including humpback whales, the whale shark and turtles. The operational area also overlaps BIAs for pygmy blue whale (distribution), humpback whale (migration) and flatback turtle (internesting).

A PMST Search was conducted on a 20km buffer around the defined operational area to identify any MNES species within the vicinity upon which noise impacts may occur. The following species (potentially impacted by noise) were identified as potentially occurring within a 20km buffer in addition to those identified to occur within the defined operational area:

- Sei Whale
- Fin whale
- Dugong
- Shortfin mako
- Longfin Mako

Marine Mammals

Cetaceans may travel through the area, particularly given the migration BIA for the humpback whale and the distribution BIA for the pygmy blue whale overlap the operational area. Additionally, conservation advice and management plans for humpback whales and blue whales list noise interference as a potential threat. Both these species are low-frequency cetaceans. Low (baleen whales) and mid-frequency (toothed whales except porpoises) cetaceans may frequent the operational areas. There are no known aggregation, resting, breeding or feeding areas for cetaceans in close proximity to the operational area. Dugongs may also frequent the area, although the BIA is not within the operational area or 20 km buffer.

Whales are low-frequency hearing cetaceans with an estimated functional hearing frequency range of 7–22 kHz (Southall *et. al.*2007). Dugong sensitivity range is between the low-frequency and mid-frequency cetaceans (NMFS, 2018), for the purposes of risk assessment dugongs are classed as 'low frequency' in accordance with the NMFS guidance.

The threshold criteria that is currently recognised for the potential behavioural impacts to marine mammals is 120 dB re 1 µPa SPL (unweighted) for non-impulsive noise sources (NOAA, 2019).

PTS and TTS onset thresholds have been identified for low frequency cetaceans and dugongs, and high-frequency cetaceans (Southall et al 2019) which are weighted SEL24h received levels:

- PTS onset threshold: 199 dB re 1 $\mu Pa^2 \cdot s$ (low frequency cetaceans and dugongs)
- PTS onset threshold: 198 dB re 1 $\mu Pa^2 \cdot s$ (high frequency cetaceans)
- TTS onset threshold: 179 dB re 1 $\mu Pa^2 \cdot s$ (low frequency cetaceans and dugongs)
- TTS onset threshold: 178 dB re 1 $\mu Pa^2 \cdot s$ (high frequency cetaceans)

Behavioural responses to noise are highly variable and context-specific; higher received levels are not always associated with stronger behavioural responses (Southall et al. 2007; Gomez et al. 2016). Different individuals or groups may respond differently depending on their behaviours and motivation at the time (e.g. foraging, socializing, reproduction) and sudden exposure to noise may also result in more apparent responses than more gradual exposures (Gomez et al. 2016). Auditory masking impacts may occur when the mammal is close to the vessel, and the more overlap there is with their vocalisation frequencies, the higher the probability of masking. The potential for masking and communication impacts is therefore classified as high near the vessel (within tens of metres), moderate within hundreds to low thousands of metres (Clark et al., 2009).

Cetaceans approaching the activity will be gradually exposed to increasing noise levels and, therefore, animals will not be startled by sudden or loud noises and behavioural responses are expected to be limited. Based on these findings however, it is reasonable to expect that significant behavioural responses such as avoidance are more likely to occur in closer proximity to the sound source and in response to higher sound levels. There is the potential for some cetaceans to display some level of avoidance when in close proximity to the vessels and MODU.

PTS is not considered likely to occur due to the predicted sound levels from vessels on DP and the MODU whilst drilling, with sound levels below the PTS threshold for marine mammals (up to 190 dB re 1Pa during drilling and up to 182 dB re 1Pa for a vessel on DP) in the immediate proximity and the sound levels decreasing with distance from the source .

TTS could be expected to occur if marine mammals remain in close proximity to support vessels for 24 hours, but as vessels will be moving throughout the activity this is considered unlikely. Although some studies show the threshold for TTS could be met, this level of noise drops rapidly with distance and dropping below the behavioural threshold level within 1 to 1.4 km of the MODU (Austin et al, 2018; Marine Acoustics 2001). For vessels, the behavioural threshold of 120 dB re 1Pa is likely to be met within a similar distance of 1-2km. As discussed above, marine mammals may be attracted by the noise sources but are unlikely to remain in the vicinity or approach close enough to result in TTS, particularly given predictions are conservative and typically consider 24 hours of exposure.

Reactions of whales to circling aircraft (fixed wing or helicopter) are sometimes conspicuous if the aircraft is below an altitude of approximately 300 m, uncommon at 460 m and generally undetectable at 600 m plus (NMFS, 2001). Baleen whales sometimes dive or turn away during overflights, but sensitivity seems to vary depending on the activity of the animals. The effects on whales appear to be transient, and occasional overflights are not thought to have long-term consequences to cetaceans (NMFS, 2001). Observations by Richardson and Malme (1993) indicate that, for bowhead whales, most individuals are unlikely to react significantly to occasional low-flying single helicopter passes ferrying personnel and equipment to offshore operations at altitudes above 150 m. Leatherwood et al. (1982) observed that Minke whales responded to helicopters at an altitude of 230 m by changing course or slowly diving.

Although there are likely to be transient whales passing through the Operational Area (refer Section 3.6.3), it does not contain any significant feeding, breeding or aggregation areas for marine mammals. The migration BIA for the humpback whale and the distribution BIA for the pygmy blue whale overlap the operational area. However, the area affected by the noise sources represents a small proportion of the overall BIAs and is unlikely to present a barrier to movement or disrupt migratory pathways or behaviour.

The Blue Whale Conservation Management Plan 2015–2025 (DoE, 2015) lists noise disturbance as a threat, specifically relating to impulsive sound sources and acute industrial noise such as pile driving. Shipping noise in busy shipping channels is also identified as a potential source of noise emissions, although the risk assessment determines that consequences would be restricted to individuals, and no population level effects expected. The plan also recognises that avoidance of these activities is typically shown. The plan requires that anthropogenic noise in distribution areas will be managed such that any blue whale continues to utilise the area without injury. As defined by the guidance on key terms in the CMP (DAWE, 2021), injury is considered to be either PTS or TTS from underwater noise. The received levels from the MODU and vessels will decline rapidly from the source and be below thresholds for PTS at source and below TTS within approximately 1.4 km of the source. As injury is not expected as a result of continuous sound sources resulting from the activity, impacts will be managed in adherence with the Management Plan.

Generally, the spatial and temporal scale of behavioural response effects on marine mammals would be limited to the localised area surrounding the MODU (thousands of metres) and the periods of intensified activities such as vessel re-supply.

Impacts to cetaceans from underwater noise generated by the activity is considered negligible.

Marine Reptiles

The internesting buffer BIA and habitat critical to the survival for flatback turtles intersect the operational area. Studies have demonstrated however, that the suitable internesting habitat for marine turtles is more likely to remain in water depths of <20m and within 10km of the coastline (Whittock et al., 2016), Fossette et al, 2021). Therefore, while marine turtles may be present in offshore waters during the internesting period, they are typically freely moving through these areas before they return to shallow waters to rest in the days leading up to nesting activity, and foraging can occur outside of designated BIAs but typically in shallower water depths than those of the operational area.

The Recovery Plan for Marine Turtles in Australia (2017) identifies noise interference as a threat to marine turtles and suggest the impact of noise on turtle stocks may vary depending on whether exposure is acute or chronic. The plan refers to vessel noise and the operation of some oil and gas infrastructure as sources of chronic (continuous) noise in the marine environment, exposure to which may lead to avoidance of important turtle habitat. This activity will result in chronic noise rather than acute, from the vessel movements.

Thresholds for sea turtle injury (PTS) and hearing impairment (TTS) have been identified and are considered likely similar to those of fishes rather than marine mammals. Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range between 100 – 700 Hz (Bartol and Musick, 2003). Reported responses of turtles to high levels of anthropogenic noise include increased swimming activity and erratic swimming patterns (McCauley et al., 2002). The following thresholds are widely accepted for marine turtles (Finneran et al 2017):

- Behavioural response: 166 dB re 1 µPa
- PTS: 220 dB re 1 µPa
- TTS: 200 dB re 1 µPa

As the MODU and vessels are not expected to generate sound levels above the PTS and TTS levels, only a behavioural response is expected from marine reptiles. Popper et al (2014) presented risk based criteria for masking and behavioural impacts, where there is high risk of behavioural impacts within tens of metres, moderate risk within hundreds of metres and low risk within thousands of metres. This would therefore assume potential behavioural impacts that are near to the activity, which given the distance from the nearest coastlines and the water depths of 49m is unlikely to have any population level effects, with recovery to individuals within days to weeks (as soon as they move away from the area).

Sea snakes may also be affected by noise, although as they generally associated with reef systems including at coral reefs (the closest are approximately 32 km away from the Operational Area at the Dampier archipelago), it is considered unlikely they will frequent the Operational Area.

Fish, sharks and rays

A number of shark species may also occur in the region, including the EPBC Act listed whale shark, though the operational area does not overlap any fish, shark or ray BIAs. Approved Conservation Advice for Rhincodon typus (whale shark) (2015) does not identify noise interference as a threat to the species. Elasmobranchs (rays, skates, sharks) rely on low frequency sound to locate prey (Myrberg, 1978). The large hearing structure of the whale shark will be most responsive to long-wave, low-frequency sound (Myberg 2001) in the range of 20 and 800 Hz. Elasmobranchs do not have swim bladders and are not typical hearing specialists (Baldridge, 1970).

Fish sensitivity and resilience to underwater noise varies greatly depending on the species, hearing capability, habits, proximity to the noise source, and the timing of the noise (i.e. the noise may occur during a critical part of the fish's lifecycle; McCauley and Salgado-Kent, 2008). Most marine fish are hearing generalists

(Amoser and Ladich, 2005) with relatively poor hearing. Hearing generalists are not as sensitive to noise and vibration as hearing specialists, which have developed hearing specialisations and can be particularly vulnerable to intense sound vibrations because many possess an air-filled swim bladder (Nedwell et al. 2004).

Popper et al. (2014), a working group of leading experts, suggested that behavioural responses in fish, which are less sensitive to noise than cetaceans, are more likely to occur within tens or hundreds of metres from vessels and other continuous/ non-impulsive noise sources. While fish may show an initial behavioural response, fish are known to quickly habituate to continuous noise sources (Smith et al. 2004; Wysocki et al. 2006; Spiga et al. 2012; Nichols et al. 2015; Johansson et al. 2016; Holmes et al. 2017). In particular, many fish species are known to aggregate around the foundations of oil and gas platforms and subsea structures, despite operational noise. Therefore, behavioural impacts fish are expected to be limited and highly localised.

The criteria defined in Popper *et al*. (2014) for continuous noise sources has been applied to the assessment of impacts to sharks, rays and fish (Table 6-2).

Table 6-2: Continuous noise: criteria for noise exposure for fish (adapted from Popper *et al*., 2014)

Potential marine fauna receptor	Mortality and potentially mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Type 1 Fish: No swim bladder (particle motion detection) includes sharks and rays.	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Type 2 Fish: Swim bladder not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Type 3 Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 h	158 dB SPL for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Note: Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N) – tens of metres, intermediate (I) – hundreds of metres, and far (F) – thousands of metres.

Based on this study, vessel/MODU noise has a low risk of resulting in mortality for all fish types. The risk of recoverable injury to Type 1 and 2 fish is low, however is moderate for TTS and behavioural impacts when fish are within tens of metres of an activity vessel (Popper *et al*., 2014). For Type 3 fish, recoverable injury and TTS may occur within 60 m of the source (McPherson *et al*., 2019), with a high risk of behavioural impacts occurring within tens of metres of an activity vessel (Popper *et al*., 2014). Noise effects to fish of potential commercial value would be restricted to within hundreds of metres of the noise source.

As such any impacts to fish, sharks or rays are expected to be negligible.

Cumulative Impacts from activities at the CPF and MODU

Cumulative noise from the MODU and/or multiple project vessels operating in the Operational Area adjacent to the CPF may result in slightly elevated noise levels, though this is not expected to significantly increase impacts to marine fauna as the sound sources will be similar sources (as described above). Noise from platform and MODU operations is expected to be low as operating equipment including generators, engines and machinery is above sea level. The frequency and noise level received underwater will depend on a number of variables including the type of infrastructure; the types and sizes of engines; as well as the local hydro-acoustic and geo-acoustic environment.

Cumulative effects could occur from the additional noise sources resulting in behavioural impacts to fauna in the vicinity of the activities, through the combination of vessels, MODU and CPF. However, the MODU is a jack-up with most noise generating machinery located above the sea surface which significantly reduces the transmission of noise through the water column. Vessel noise will be intermittent with the vessels servicing the CPF and MODU, and it is unlikely that activities involving multiple vessels (such as inspection and maintenance) would be occurring at the same time as drilling due to the logistics of multiple vessels in field and SIMOPS with the CPF.

Cumulative impacts from multiple noise sources is not considered significant given the received levels from these types of activities. Additionally, the noise impact thresholds for PTS and TTS consider the received levels over a period of 24 hours, and as discussed above, marine fauna may be attracted by the noise sources but are unlikely to remain in the vicinity for 24 hours, or approach close enough to result in TTS. Ipact predictions are conservative and typically consider 24 hours of exposure.

Overall Consequence assessment: Negligible

6.2.3 Environmental Performance

Hazard		Noise (EPH-02)		
Performance outcome		**Controls implemented to ensure no death or injury to EPBC listed marine fauna from noise emissions**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
6	Vessels will comply with EPBC Regulations 8.05 and 8.06, as per Stag Marine Facility Operating Manual (GF-90-MN-G-00038)	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: - Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and - If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines, or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots. - The above requirements will also apply to whale sharks if they are sighted within 300 m of the vessel.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed by Vessel Master. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans) Induction includes whale shark avoidance requirements	Supply Chain Lead Vessel Master Drilling Manager
7	Helicopters will comply with EPBC Regulations 8.07	Helicopters will comply with the following elements of EPBC Regulations 2000 Regulation 8.07, except during take-off/ landing, during an emergency or when action is required to maintain safe operations: - A helicopter will not operate at a height lower than 1,650 ft or within a horizontal radius of 500 m of a cetacean; and - A helicopter will not deliberately approach a cetacean from head-on. Helicopter operators are required to report any instances where these standards are breached, and any event involving injury to or death of marine fauna due to helicopter operations.	Helicopter Contractor's procedures reflect EPBC regulations 8.07. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans)	Supply Chain Lead
8	Safety Case requires MODU machinery is certified and maintained	MODU machinery is maintained in accordance with the MODU PMS.	PMS provides status of maintenance	Drilling Manager
9	Valid Flag State Certificate indicates vessel machinery and equipment is certified and maintained	Vessel machinery is maintained in accordance with Flag State certification requirements. Maintenance is conducted in accordance with the vessel maintenance management system.	Flag State Certificate / ISM.	Vessel Master

43	Vessels operate at speeds in accordance with Stag Marine Facility Operating Manual (GF-90-MN-G-00038) to reduce potential for collision with marine fauna	Vessels operating within the restricted zone must not exceed a speed of five (5) knots.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed by Vessel Master.	Supply Chain Lead
44	Competency and Training Management System (JS-60-PR-Q-00015) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	Vessel Master

6.2.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage the impact and risk of noise due to operation of machinery, vessels and helicopters during the drilling activities. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected Control	Hierarchy	Practicable	Cost-effective	Justification
Remove machinery that emits noise	Eliminate	No	N/a	Noise from the MODU, vessels, helicopters and machinery cannot be eliminated. Without these assets, the activities cannot be undertaken.
Replace machinery that emits noise with quieter machinery	Substitute	No	No	All equipment as listed is required; no opportunities for substitution were identified.
Provide additional muffling on machinery, or design to reduce noise emissions	Engineering	No	No	Machinery is generally designed with human health hearing requirements taken into consideration, reducing operating noise to as low as efficiently and cost effectively as possible.
Do not operate noisy machinery in areas of sensitivity	Isolation	No	N/a	The drilling activities are located at distance from sensitive receptors and the coastline. Other fauna in the vicinity may experience short term behavioural effects only.
Minimise activity on the CPF and do not undertake any additional vessel based inspection and maintenance activities during drilling activities	Isolation	No	N/a	During drilling, it is imperative to have adequate crew members on the CPF to ensure that SIMOPS are implemented and activities completed safely, therefore ongoing operations will continue during drilling. There is the potential for a routine inspection and maintenance activity to be undertaken during the drilling period, although it is not planned, an unplanned activity may be required and therefore cannot be eliminated. Though to ensure cost-effectiveness, vessels may serve a dual purpose to the drilling activity and the ongoing operations simultaneously, thereby minimising the number of vessels in the field.
Manage the timing of the activity to avoid sensitive periods such as migration (whales), spawning (fish) or internesting	Isolation	No	N/a	There is a high cost associated with changing or delaying the activity schedule due to MODU availability and the risk to all listed fauna cannot be completely removed due to the variability in timing of environmentall sensitive periods. The operational area

(turtles)				overlaps with the humpback whale migration BIA the distribution BIA for pygmy blue whales and internesting BIA for flatback turtles and these species could also be present all year round. However, the potential impacts to cetaceans and turtles are predicted to be low and if they occur would be within ~1 km of the vessel and equipment and with the controls in place to ensure compliance with EPBC Regulation 8 and reduce vessels speeds (to lower the potential impacts of noise), the potential for impact is significantly reduced. The activity will not restrict the movement of whales or turtles within the area as the BIA and the area within which they are distributed in is widespread. Cost is disproportionate to increase in environmental benefit.
Additional activity specific noise emissions procedures for assets	Administrati ve	No	No	Through the application of EPBC Regulation 8 for helicopter and vessel marine fauna interaction procedures, vessel speed restrictions, inductions for personnel on interacting with marine fauna, and application of machinery maintenance, potential impacts are reduced. No further procedures are considered necessary.
Dedicated Marine Mammal Observer (MMO) (as per EPBC Policy Statement 2.1 – Part B.1)	Administrati ve	No	No	This would require an additional cost of contracting several specialist marine fauna observers, and even if marine fauna are identified, noise sources cannot be shut down in the event marine fauna are detected, since they are integral to safe operation of vessels and MODU. Therefore the cost is disproportionate to the increase in environmental benefit given the potential impacts are expected to be short term behavioural impacts for marine mammals.

6.2.5 Acceptability Assessment

The potential impacts of drilling, helicopter and vessel noise emissions are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from noise on sensitive receptors.
Laws and standards	Noise emissions from topsides equipment on the MODU, supply and support vessels machinery are managed through maintenance of equipment as per safety legislative and regulatory requirements administered by NOPSEMA and Flag State. EPBC Regulation 8 and the Australian National Guidelines for Whale and Dolphin Watching 2017 (Commonwealth of Australia 2017b) control vessel speeds.
Industry best practice	Noise from MODU, helicopters and vessel equipment is designed to be at minimum safe operational levels. The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to offshore production operations.
Environmental context	While there are noise emissions to sea surface immediately around the MODU and vessels, the impact and risk assessment process indicates that noise will not result in death, injury or significant long-term behavioural effects to marine fauna. This is in alignment with relevant conservation advice and recovery plans for EPBC species that may occur in the Operational Area including humpback, blue whale and whale sharks. Jadestone intends that any impacts from noise generating activities are not inconsistent with protected area management plans or relevant IUCN principles. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	Noise interference is identified as a threat to fauna that may be present in the operational area and 20 km buffer in: - The Recovery Plan for Marine Turtles in Australia (2003) - The Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) - Approved Conservation Advice for Balaenoptera borealis (sei whale) (TSSC, 2015b) - Approved Conservation Advice for Balaenoptera physalus (fin whale) (TSSC, 2015c) Which suggest noise may lead to the avoidance of important habitat in marine turtles and mask cetacean vocalisations. The Operational Area overlaps with the flatback turtle internesting BIA, the humpback whale migration BIA and the pygmy blue whale distribution BIA. Given the noise sources used during the drilling activity, distance from the Operational Area to the closest turtle nesting site at Dampier Archipelago (32 km) and the large navigable

	area available in the open ocean to these species, it is expected that the impact of noise interference on individual transient turtles or cetaceans travelling through the Operational Area is expected to result in temporary avoidance reactions. Avoidance of migratory or nesting seasons is not considered to be ALARP given the low levels of noise from the planned activities, no predicted PTS impacts to fauna and short term activities. The risk matrix presented within the Recovery Plan for Marine Turtles in Australia provides a risk rating of low to moderate associated with industrial and shipping noise on turtles. No further controls are considered appropriate given the distance from turtle BIAs and the low levels of noise from the proposed activity. The risk matrix presented within the Conservation Management Plan for Blue Whales (DoE (2015)) provides a risk rating of low to moderate associated with industrial and shipping noise on blue whales. The proposed controls including reduction of vessel speed in the vicinity of a whale align with the priority for action recommended in this management plan. Jadestone has had regard to the representative values of the protected areas within the RISK EMBA, and the respective management plans and other published information. Impacts from noise will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans and considered acceptable. The Approved Conservation Advices for Balaenoptera borealis (sei whale) and Balaenoptera physalus (fin whale) (TSSC, 2015b,c) identify anthropogenic noise and acoustic disturbance as a threat with a consequence rating of minor. No specific controls to manage noise are identified. EPBC Regulation 8 and the Australian National Guidelines for Whale and Dolphin Watching 2005 (DEH 2006) set the requirements for vessels interacting with cetaceans.
ALARP	The residual risk has been demonstrated to be ALARP.

6.3 Atmospheric Emissions

6.3.1 Description of Hazard

Aspect	The use of fuel (specifically marine-grade marine diesel) to power MODU and vessel engines, generators and mobile and fixed plant and equipment will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SO_x) and nitrous oxides (NO_x). Vessels and the MODU may utilise ozone-depleting substances (ODS) in closed-system rechargeable refrigeration systems. No flaring will occur during the drilling activities.

6.3.2 Impacts

Emissions can reduce air quality in the immediate vicinity of the MODU or vessels present in the Operational Area. The quantities of gaseous emissions are relatively small, and will under normal circumstances, quickly dissipate into the surrounding atmosphere.

A reduction in air quality may have a temporary effect on transient bird species passing through the Operational Area. The wedgetail shearwater breeding BIA overlaps the Operational Area and 18 threatened and/or migratory seabirds were identified as potentially transiting, occurring within, or having habitat potentially occurring within the greater region. These species may be impacted by deterioration in air quality if they are transiting the immediate area of the vessel and MODU exhaust release points. Symptoms of exposure could include irritation of eyes and respiratory tissues or breathing difficulties.

Due to the distance from the nearest coastlines (32 km to Dampier archipelago), and the size of the wedge-tailed shearwater BIA only a small number of seabirds are expected to be affected by a reduction in air quality whilst in transit, any behavioural disturbances such as alteration of flight path would be a slight effect; recovery in days to week.

There are no known air quality standards or guidelines specifically for avifauna. However, if avifauna are exposed, it is expected they would only be exposed to changes in air quality for an extremely short period. Chronic exposures are not considered credible given that avifauna would be transiting through the area. As such impacts to seabirds are considered negligible.

As the proposed drilling activities will occur in offshore waters, the combustion of fuels in such remote locations will not impact on air quality in coastal towns or other sensitive locations, and impacts to nearby petroleum activities such as Wandoo facility operated by Vermillion Energy (approximately 20 km north-east) are not expected.

Cumulative Impacts from activities at the CPF and MODU

The quantities of gaseous emissions are relatively small, and will under normal circumstances, quickly dissipate into the surrounding atmosphere and not result in significant cumulative impacts from the CPF and MODU. Given the distance from the nearest coastlines where birds will likely congregate, with only individuals overflying the location, cumulative impacts at a population level are not expected.

Overall Consequence assessment: Negligible

6.3.3 Environmental Performance

Hazard		**Atmospheric emissions (EPH-03)**		
Performance outcome		**No unplanned emissions to the atmosphere** **Emissions to air meet regulatory requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
10	Flag State Certificate (IAPP) certifies measures are in place to manage air emissions	A current International Air Pollution Prevention (IAPP) Certificate that confirms: - Incinerators are certified to meet prescribed emissions standards - Marine diesel engines >130 kW are certified to meet prescribed emission standards - Current waste management plan - Measures in place to prevent ODS emissions	Valid and current statutory Certificate (IAPP) Waste Management Plan	Vessel Master

6.3.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage atmospheric emissions from the MODU, as well as vessels and helicopters. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
All emissions-producing equipment is removed	Eliminate	No	N/a	Atmospheric emissions from the MODU, vessels and helicopters are required to undertake the activities. Equipment cannot be removed completely.
All emissions-producing equipment is substituted for equipment that does not produce emissions	Substitute	No	N/a	All equipment as listed is required; no opportunities for substitution were identified.
Equipment is re-designed/ replaced with equipment designed to reduce emissions.	Engineering	Yes	No	Risk and impact reduction are achieved through planned maintenance ensuring clean and efficient running of engines. Given the volumes of emissions generated, and the low impact considerations due to the location and duration, the costs associated with alternative power generation arrangements are considered disproportionate to the benefits that would be gained.
None identified	Isolation	N/a	N/a	The activities are located at distances from sensitive receptors and the coastline.
None identified	Administrative	N/a	N/a	Compliance with relevant and appropriate MARPOL requirements

6.3.5 Acceptability assessment

The potential impacts of atmospheric emissions are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from atmospheric emissions on sensitive receptors.
Laws and standards	Atmospheric emissions from drilling and operational equipment are compliant with MARPOL.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate.
Environmental context	While there are atmospheric emissions to the airshed immediately around the MODU and vessels, the impact and risk assessment process indicates that emissions will not result in significant effects to the environment or receptors. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management/ Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD.
Conservation and management Plans	No Management Plans identified air emissions such as those described above as being a threat to marine fauna or habitats. Jadestone has had regard to the representative values of the protected areas within the RISK EMBAs, and the respective management plans and other published information. Impacts from atmospheric emissions will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.4 Operational Discharges

6.4.1 Description of Hazard

Aspect	Planned discharge of operational wastes includes domestic discharges (sewage, grey water and food waste), deck drainage and bilge water, cooling water, desalination brine, and ballast water. Domestic discharges All sewage (including grey water) generated onboard the MODU and support vessels is discharged through an inline macerator to comminute solids to a diameter of less than 25 mm. The discharge estimates are based on the known number of personnel on the assets discharging an estimated 100 l/ person/ d. The MODU allowable personnel on board (POB) is approximately 110, while the support vessels typically have 12 POB. This loading includes sewage as well as grey water from laundry, showers and wash basins, and food waste from the kitchen. Tertiary treated wastewater on the MODU is discharged directly to the ocean via a sewage treatment plant (STP). Deck drainage Drainage from open decks (rainwater and deck wash) goes directly overboard through open scuppers. Machinery spaces, such as the cement unit, are drained to a slops tank for treatment. Deck drainage may contain minor quantities of oil, grease and detergents from machinery and residual cleaning agents if present on the decks. Bilge water Oily water from bilges will be collected and treated via an oil-water separator in accordance with MARPOL requirements (<15 mg/L (v) oil-in-water). Once separated, the oil and grease will be stored in suitable containers ahead of transfer ashore for recycling and the treated water discharged to ocean. Cooling water Seawater is used as a heat exchange medium for the cooling of power generators used on the MODU and support vessels. Cooling water is drawn through a segregated cooling system and is therefore not contaminated by engine oils or other liquid discharges from the process. Discharge water is approximately 3°C above ambient marine waters but for the MODU will have cooled to ambient by the time it reaches the sea surface (as discharged approximately 20m above sea surface). Desalination brine The freshwater systems used on the MODU and support vessels are designed to produce, store and distribute fresh and potable water. During normal operations, fresh and potable water is produced via a desalination process and results in a brine discharge approximately 10% higher salinity than the intake seawater, and low concentrations of anti-scale chemicals. Ballast water The MODU will exchange ballast water outside the 500m exclusion zone during mobilisation and demobilisation. When first jacking up on location the MODU will take on ballast to pre-load the spud cans. This is further discussed in Section 7.1.

6.4.2 Impacts

Operational discharges will be small and continuous and dependent on rainfall, the number of persons onboard and machinery activity. Operational discharges will result in a reduction in water quality of the receiving marine waters immediately nearby the discharge outlet. This will be temporary (hours), localised and limited to the surface waters (<5 m), due to the small volumes and warm/ fresh qualities of the discharge streams. The discharges will be dispersed and diluted rapidly with increasing distance from the discharge point, so that temporary changes to ambient conditions are unlikely outside the 500m exclusion zone around the MODU. It is noted that the Operational Area overlaps with the humpback whale migration BIA and pygmy blue whale distribution BIA, shearwater breeding BIA, and the flatback turtle internesting buffer BIA which may result in a higher number of these species in the area. Potential impacts to water quality are likely to be limited to the immediate vicinity (tens to hundred metres) of the release point, and are not expected to affect overall population viability of these protected species. Specific water quality impacts are considered as follows.

Sewage

The routine discharge of sewage is likely to result in localised increases in nutrient concentrations, levels of phytoplankton and bacterial activity, and biological oxygen demand (BOD).

In terms of BOD, the open water conditions and swift currents of the receiving environment will dilute the discharge and prevent environmentally significant reductions of oxygen levels in the water column (Somerville et al., 1987, cited in Swan et al., 1994).

Some fish and oceanic seabirds may be attracted to the MODU and support vessels by the discharge of sewage. This attraction may be either direct, in response to increased food availability, or secondary, as a result of prey species being attracted to the area. Given the small quantities and intermittent nature of disposal however, any attraction is likely to be minor and is not expected to result in adverse impacts at an ecosystem or population level.

While marine mammals and reptiles may transit through the area there are no feeding, breeding or other aggregation areas nearby. The localised extent of any increases in BOD, nutrients, bacteria or phytoplankton and short visit times of these fauna suggest that any impacts from discharge of sewage would be unlikely.

Deck drainage

Discharges from vessel and MODU deck drainage may include residues of chemicals used for cleaning decks.

The potential impact associated with the discharge of treated deck drainage and bilge water is chemical toxicity to marine species within the direct vicinity of the vessel.

If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality and toxic effects to marine fauna. Toxicity to marine organisms would be from small amounts of dissolved hydrocarbons in the oily water drainage after treatment. Given that oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment.

Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on marine ecology. The consequence was assessed as negligible..

There may be a localised and temporary (hours) reduction in water quality in the immediate vicinity of the release. Toxicity impacts to marine fauna from the release of chemicals are unlikely to eventuate because:

- strong ocean currents result in the discharge being further diluted upon release to the marine environment, so the duration of exposure of chemicals to fauna will be minimal
- deck cleaning products planned to be released to sea will meet the criteria for not being harmful to the marine environment according to MARPOL Annex V
- potential discharges will be intermittent and temporary within the operational area

Bilge water

If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality and toxic effects to marine fauna. Toxicity to marine organisms would be from trace amounts of dissolved hydrocarbons in the oily water drainage after treatment. Given that oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment.

Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on water quality or marine ecology.

Cooling water

The potential impacts arising from discharge of cooling water include:

- Thermal impacts to marine organisms; and
- Decline in water quality associated with lowered dissolved oxygen concentrations as a result of elevated water temperature.

When discharged to the sea surface, cooling water will initially be exposed to the atmosphere and subsequently air-cooled. Upon reaching sea surface cooling water will then be subjected to turbulent mixing and some transfer of heat to surrounding waters. The plume will disperse mainly within surface waters being thermally buoyant, primarily in the direction of prevailing tidal currents (northwest–southeast).

The natural range in sea surface temperature at the drilling locations is between a low monthly average of 24°C (winter and spring) and high of 27°C (summer) (APASA, 2013). Assuming that a localised area around discharge locations was raised by 2°C (as modelled at the Van Gogh field) a range of 26 to 29°C may be experienced.

Discharge of cooling water has the potential to cause changes in marine ecology through elevated temperatures, as well as the presence of anti-fouling biocides with trace chemical concentrations of copper and aluminium ions being discharged. These small amounts of biocides will disperse rapidly on discharge to concentrations below levels of environmental concern to marine biota especially demersal fauna.

Fish and plankton are likely to be at greatest risk from cooling water discharge impacts since they are most likely to be attracted to the discharge location (fish) or entrained within the discharge plume (plankton). Fish and plankton are relatively small organisms that may experience increased body temperature and altered physiological processes (e.g. increased respiration rate and oxygen demand). However, given that the area of raised water temperature will be highly localised and within the range of temperature on the North-West Bioregion, significant impacts on a larger ecosystem or population levels to fish or plankton are not expected to occur.

Given the hydro-dynamically active open water environment surrounding the Operational Area, it is expected that the surface discharge of cooling water would rapidly disperse, cool and dilute in the surrounding waters, therefore temperature and biocides leading to changes to water quality or behavioural changes in marine species would be negligible. Only receptors in close proximity to the discharge point have the potential to be impacted with full recovery predicted within weeks..

Desalination brine

The potential impacts of desalination brine discharge on the environment include:

- Alteration of physiological processes of exposed biota; and
- Reduced water quality.

On discharge to the sea, desalination brine will sink and disperse in the currents. Given that discharged brine will have a salinity of ~10% greater than ambient seawater the largest increase of salinity experienced would be approximately 10% in the immediate vicinity of the discharge point. Most marine species can tolerate short-term fluctuations in the order of 20–30% (Walker and McComb, 1990), and it is expected that exposed organisms such as plankton, pelagic invertebrates and fish would be able to tolerate short-term exposure to the slight (maximum 10%) increase in salinity caused by the discharged brine. For large marine species that may temporarily use surface waters around the MODU and support vessels such as marine turtles, mammals and seabirds, the effect of a slight increase in salinity is expected to be negligible.

Cumulative Impacts

There is the potential for cumulative impacts from the above routine operational discharges due to the periodic discharges that occur at the CPF, MODU and vessels during the drilling activity. Given the nature of the discharges which will be in accordance with regulatory requirements (e.g. MARPOL), and the expected dissipation within the open ocean waters, the cumulative impacts from these discharges are expected to be localised with only short term impacts above background levels outside of the localised mixing zone. The nature of these discharges results in a negligible environmental impact to EPBC listed fauna, with impacts to fish and plankton greatest within the discharge plume.

Overall Consequence assessment: Negligible

6.4.3 Environmental Performance

Hazard		**Operational discharges (EPH-04)**		
Performance outcome		**No unplanned operational discharges within the Operational Area** **Operational discharges to sea are in accordance with legislative requirements**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
	Sewage			
11	MODU STP operated in line with MARPOL requirements	Current International Sewage Pollution Prevention Certificate for MODU	Valid ISPP Certificate	MODU OIM
12	Maintenance of sewage system: vessels >400 t	Current International Sewage Pollution Prevention Certificate for vessels >400t	Valid ISPP Certificate	Vessel Master
	Bilge water			
13	Oily water filtering and monitoring equipment fitted and maintained	If required under MARPOL Annex I, support vessels have oily water filtering and monitoring equipment that is compliant and surveyed/ maintained as per MARPOL Annex I and an IOPP certificate	Current IOPP	Vessel Master

6.4.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage operational discharges from the MODU and support vessels. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Wastes stored onboard and transferred to shore for onshore treatment and disposal	Eliminate	No	No	Costs associated with complete re-engineering such that wastes contained onboard and disposed of onshore, onshore treatment and disposal costs and increase in fuel consumption due to multiple vessel transfers would be disproportionate to the environmental benefit gained given the rapid dilution in offshore water and low potential impact from discharges. In addition, transfers increase the risks of spills/ leaks and safety risks to personnel during transfer operations.
Reduce toxicity of discharges	Substitute	No	No	Provide for further treatment of wastes prior to discharge to sea such as decreasing the oily water concentration below MAPROL requirements, additional treatment of sewage, desalination and cooling water so the discharge is similar to the surrounding ambient sea water. This would require complete re-engineering of equipment and would be disproportionate in cost compared to the environmental benefit gained given the rapid dilution in offshore water and low potential impact from discharges.
Re-engineer equipment to retain wastes onboard	Engineering	No	No	Costs associated with complete re-engineering such that wastes contained onboard and disposed of onshore would be disproportionate to the environmental benefit gained. There is not enough space on board the MODU or vessels to have storage tanks for all the waste produced prior to transferring to a vessel for onshore treatment and disposal. Substantial additional costs for re-engineering is grossly disproportionate to the benefit gained.
N/a	Isolation	N/a	N/a	The activity is located at distance from sensitive receptors and the coastline and no significant impacts to receptors are predicted.
N/a	Administrative	N/a	N/a	Maintenance management system implemented, compliance with relevant and appropriate MARPOL requirements and certified equipment ensure discharges meet regulatory requirements.

6.4.5 Acceptability Assessment

The potential impacts of operational discharges are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regard to impacts from operational discharges on sensitive receptors.
Laws and standards	Operational discharges are compliant with MARPOL.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate.
Environmental context	While there are operational discharges to sea surface immediately around the MODU and from vessels, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna. The potential impacts are considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management/ Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD.
Conservation and management advice	No Management Plans identified operational discharges such as those described above as being a threat to marine fauna or habitats. Most of the plans identify pollution and habitat degradation relating to more significant (and usually unplanned) discharges to sea and therefore they were not considered relevant to these discharges which are all in accordance with legislative requirements such as MARPOL. Jadestone has had regard to the representative values of the protected areas within the RISK EMBAs, and the respective management plans and other published information. Impacts from liquid discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.5 Drilling Discharges

6.5.1 Description of Hazard

Aspect	During the Activity, drilling discharges to the marine environment will be made, including fluids, cuttings and cement (slurry and dry bulk solids). Depending on the stage of drilling, discharges will occur at sea surface and at seabed.

During the drilling activity, discharges of drilling fluids, cuttings and cement will occur to the marine environment. In the interests of the impact assessment provided in Section 6.5.2, a summary of the potential discharges to the marine environment that will occur at sea surface and at the seabed have been provided (Table 6-3). For noting, these volumes include discharges that will be made during the drilling activities as well as disposal of waste volumes that may occur at the end of the activities and are approximate only.

Table 6-3: Drilling discharges to the marine environment

Activity	Discharge	Estimated amount per well
Drilling of new wells 50H and 51H	Seawater/PHG and WBM	1600 m^3
	Cuttings	200 m^3
	Cement	70 m^3
P&A of 38-H and 44-H	Seawater/PHG and WBM	N/a
	Cuttings	N/a
	Cement	4 m^3

Cutting discharge volumes are calculated based on the hole size (diameter) and interval length. The total volume of drilling fluid, brine and drill cuttings is an estimate based on previous drilling and completion programs. Discharge volumes could exceed the range estimates should the drilling program change or due to operational delays (e.g. interval length change).

6.5.2 Impacts

Environmental receptors have the potential to be impacted by drilling discharges through reduction of water quality (turbidity and toxicological effects), and smothering due to sediment deposition to the benthos from particulates discharged to the water column, displacement of mud during drilling of the riserless sections of the new production well, and extrusion of cement during cementing operations.

The EMBA by drilling discharges has been defined as up to 1 km surrounding the MODU within the Operational Area at both sea surface and at the seabed. This is based on the potential for finer particles to distribute within the upper water column, as the sampling of sediment undertaken infield previously indicates that contaminants are at background level and the sediments are no different to control areas within 250m of the CPF (refer Section 3.3.1).

Water quality

When brines/gels, WBM and cuttings are discharged to the ocean, the larger suspended particles and flocculated solids, representing about 90 % of the mass of the mud solids, form a plume that settles quickly to the seabed.

The remaining 10% of discharged mass of mud solids, comprising fine-grained unflocculated clay-sized particles of which 98% are typically <63 µm (IRCE, 2003), along with a portion of the soluble components of the mud, form a plume in the upper water column that drifts with prevailing currents away from the MODU.

The plume of suspended fine material remaining near sea surface is diluted rapidly in receiving waters (Neff, 2005). In well-mixed ocean waters, drilling muds and cuttings are diluted by 100-fold within 10 m of the discharge point and by 1,000-fold after a transport time of approximately 10 minutes at a distance of about 100 m from the MODU. Because of the rapid dilution of the discharge plume, harm to communities of water column organisms (e.g. plankton, fish) is unlikely and has never been demonstrated.

Boehm et al. (2001) concluded that drilling fluid chemicals diluted rapidly in the water column and, in all but very deep or high-energy environments, much of the drilling fluid and cuttings solids settled rapidly to the bottom near the MODU site.

A post drilling survey completed within days of drilling (Eni, 2008) confirmed that water turbidity was low as the wellhead and seabed could be seen from several metres away and epibenthic fauna and infauna burrows were common. Dispersion modelling indicated that cuttings would settle over an area 300 m from the wellhead following disposal at the sea surface with an average thickness of 4 mm on seabed surface with the exception of some localised cuttings mounds.

Studies commissioned by Apache during the drilling of Simpson-3 in 6 m water depth and within 400 m of a coral patch reef concluded that there were no adverse impacts on nearby corals (IRCE, 2004; Saunders et al., 2005). The daily monitoring of turbidity and total suspended solids did not detect differences between drilling and control monitoring sites. Arguably if light attenuation, turbidity and total suspended solids that were measured in the study were not significantly above background for prolonged periods then any impacts to other receptors such as fish and cetaceans (including the pygmy blue whale and humpback whale whose BIAs overlap the operational area) would also be minimal.

Discharge of drilling mud and cuttings at the sea surface has not demonstrated significant harm to water column flora and fauna and is highly unlikely (Neff, 2005). As the chemicals selected for use in drilling operations are highly rated (PLONOR, Gold/Silver or E/D OCNS) or alternatively are risk assessed through Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) process, as environmentally acceptable, their environmental impact will be insignificant. They are not considered to be toxic to marine fauna including fish, marine reptiles, cetaceans and seabirds that may transit through the area.

Given the large majority of discharges will occur at sea surface and will disperse through a water column >50 m deep, impacts to demersal fish that live within 5 to 10 m of the seabed are not predicted. The cuttings will settle slowly following discharges at the sea surface rather than being directly discharged at the seabed.

Smothering

Discharge at the seafloor during drilling of the first well section will occur for approximately 5 days while setting the conductor for the production well. In addition, abandonment of the existing producer wells will see cement being discharged at the seabed (~4 m^3).

The thickness and spread of piles or slabs on the seabed due to cementing and riserless drilling operations for both wells will depend on the volume of material discharged and the currents experienced in the vicinity of the drilling location. For conservatism, a 10m radial arc around the surface hole location for both wells has been adopted.

The discharge of borehole materials during riserless drilling will occur at the well opening on the seabed until after cementing of the first casing/ conductor section. The coarser cuttings discharged at the sea surface will also deposit at the seabed.

Other than in very shallow (<10 m depth) or low energy environments, drill cuttings piles are unlikely to form. Where cuttings piles do form, benthic organisms immediately below the point of discharge can be physically smothered. Recovery is dependent on the type of community affected; the physical structure and persistence of the cuttings pile itself; the presence and nature of any toxic components within the cuttings; and the availability of colonising organisms. Impacts will be localised and short-term.

Organic enrichment as a result of WBM drilling cuttings discharge increases bacterial activity which can result in an increase in the abundance and diversity of benthic fauna in the immediate vicinity of a release. As more organic enrichment occurs, the seafloor bacteria colonies consume more and more of the oxygen in the sediment, resulting in anoxic conditions. In a highly organic enriched area, the sediment can become anaerobic and both the abundance and diversity of species is much lower than normal (IOGP, 2021).

Case studies on impacts of WBM on soft sediment and benthic fauna are outlined below:

- For Apache's East Spar development, the area of impact from WBM discharges was not more than 100 m from the drill site and short lived (recovery in less than 18 months) (Sinclair Knight Merz 1996, 1997; Kinhill 1997);
- Benthic monitoring at the Stag production platform indicated that drilling-induced impacts had less of an influence on infaunal assemblages through time than small spatial scale natural variability (Kinhill 1998; CSIRO 2001; IRC 2001). Two years after the initial production well drilling, the distribution of drill cuttings was mostly restricted to within 50 m of the platform, with minor traces out to 1,000 m (refer Section 3.3.1);
- At drilling locations in shallow waters (<10 m depths), the physical impacts associated with drilling fluid discharge were manifested in a change in composition of infaunal species and/or abundance in close proximity to the drilling location (i.e. within tens of metres), however, recovery occurred within six months and cuttings mounds were no longer visible (IRCE, 2003); and
- Cuttings mounds approximately 2 m high were found surrounding the Kitan-1 well head in the Timor Sea in approximately 312 m of water (Eni, 2008). 330 m^3 of cuttings were discharged during riserless drilling and 78 m^3 following riser installation. Cuttings mounds of 5 m x 5 m to the North, 2 m x 5 m to the west and 2 m x 4 m to the southeast were identified, all within 2 m of the wellhead. Hermit crabs and fish were observed at these locations suggesting that smothering impacts were localised (Eni, 2008).

Direct smothering as a result of discharges to the seafloor is expected to cause mortality of benthic invertebrates directly under the cuttings pile. Re-colonisation by benthic invertebrates of the mud coated cuttings and the hardened cement will occur through time. The area surrounding the drilling location is sparsely populated by epifauna and flora, typical of soft sediments in the NWS area. Impacts to this habitat type would likely be temporary and recoverable within weeks to months following cessation of discharges, with rapid recolonisation of benthic infauna within the deposited layer, given the low to no toxicity of the material. Epifauna and flora associated with the sediment would also be likely to recolonise within weeks to months.

<u>Sediment contamination and impacts</u>

During drilling of these wells, drilled cuttings and WBM will be discharged to sea, where the WBM is made up of API barite and the liquid fraction of the drilling fluids. As described above, the discharge of drill cuttings can result in a change in the seabed sediments due to an increase in organic materials, the presence of chemicals in the discharged WBM and can also result in an increase in the metal concentration depending on the weighting agent.

Jadestone uses barite supplied to API standard which ensures that limitations on contaminants, including heavy metals, are adhered to. However, the use of barite does result in elevated levels of barium (Ba) in cuttings, as demonstrated in previous studies (Oceanica 2015, Kinhill 1999) which show the levels ranging from 76 – 189ppm, compared to control locations of 10.5-23ppm. Other chemicals of concern in cuttings, either because of their potential toxicity and/or abundance in WBM are arsenic (As), chromium (Cr), cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn), (Breuer et al., 2004).

Dissolved barium and any heavy metal contaminants present in the barite may slowly leach out of an anoxic cuttings pile (Neff, 2005), and may also migrate either upward to the overlying water (Ba, Mn, and Fe), or diffuse downward (Cr, Cu and Pb) where they become incorporated into Fe monosulfides (Breuer et al., 2008). If the cuttings pile remains stable and undisturbed, it is probable that the fraction of the total cuttings pile metals that is in the dissolved, bioavailable fraction remains low with some slow leaching over time. However, this slow release is unlikely to result in an increase in the concentration of metals above natural background levels (Hartley et al. 2003).

Marine fauna that are exposed in the laboratory or field to cuttings in sediments do not bioaccumulate significant quantities of metals (Hartley et al., 2003). There is some evidence of a limited bioavailability of a few metals, such as Pb and Zn, which are present in cuttings piles, however doubt remains that metal bioaccumulation in marine fauna from cuttings piles is sufficient to cause harmful effects in marine fauna living on or near cuttings piles (OSPAR, 2019). There is no indication that the levels of trace metals in fish and shellfish collected close to offshore installations are significantly above natural background concentrations (Bakke et al., 2013).

Given the nature of the cuttings discharge, and the nature of the seabed the vicinity of the operational area, the impact from a reduction of sediment quality is expected to result in a detectable but insignificant change to local population of infauna and epifauna and may result in slightly higher concentrations of metals and other contaminants above the current contamination levels but not to ecologically significant levels.

In the event of cuttings pile disturbance (e.g. future decommissioning results in disturbance), a proportion of a disturbed cuttings pile is likely to resettle on seabed sediment that may have not been previously impacted by cuttings. The potential impact this has on benthic communities results from a combination of physical smothering, changes in sediment texture/grain size, oxygen depletion, organic enrichment and direct toxicity from drilling fluids and cuttings (impacts of which are described above). This can result in a decrease in both the abundance and diversity of benthic fauna (OSPAR, 2019). Resuspension of cuttings piles into the water column as a result of disturbance gives rise to the potential for exposure of marine fauna to contaminants in the cuttings (OSPAR, 2019). The exposure of Fe monosulfides to oxygen as a result of transport of oxygen into the cuttings via pile resuspension may lead to the release of the associated metals into the water column (Saulnier and Mucci, 2000; Huerta-Diaz et al., 1998) as described above.

Modelling of cuttings pile relocation (disturbance and re-deposition) has confirmed that potential impacts of metals are minimal and disturbance of cuttings drilled with WBM are not expected to result in any significant impact (OSPAR, 2019). Generally, impacts from disturbed cuttings drilled with WBM are expected to be minor and resemble the impacts from currently consented cuttings discharges.

<u>Cumulative impacts from previous drilling activity</u>

Given the drilling activity history at the Stag location, it is considered likely that disturbance and re-deposition of cuttings piles has already occurred and will occur again when the MODU is in situ and drilling commences as the wells are in close proximity to previously drilled locations. This is likely the reason for the increase above background level that was detected in the previous surveys, though the levels of contamination are all well within 250m of the Stag platform based on the last surveys undertaken (refer Section 3.3.1). Studies also show that levels of contaminants (heavy metals and TPH, PAH, BEX) are all below guideline values indicating that historical discharges have not had significant impacts. The discharge of cuttings and WBM to sea for this activity will result in some cumulative impacts to the sediment in the contaminant levels but given the nature of the discharges, it is unlikely that this will result in significant impacts to the sediment, and the biota will likely begin to recolonise the areas soon after drilling ceases.

<u>Overall Consequence assessment: Negligible</u>

6.5.3 Environmental Performance

Hazard		Drilling discharges (EPH-05)		
Performance outcome		**No unplanned drilling discharges within the Operational Area**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
14	Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Drilling, completions and cement chemicals used downhole are Gold/ Silver/ D or E rated through OCNS, or have a complete risk assessment, as per Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033).	Completed chemical risk assessment records	Drilling Manager
15	Cuttings management system	Cuttings returned to the MODU are treated through the onboard cuttings management system to reduce the concentration of drilling mud on cuttings prior to discharge.	Surface losses as reported on the daily mud report	Drilling Manager
16		The shale shakers have API standard screens for solids removal particle size cut points.	Daily mud report	Drilling Manager
17		While drilling, the shale shakers are inspected regularly to ensure they are running and are not damaged or blinding	Daily mud report	Drilling Manager
18	Inventory control work instructions	WBM, brine and drilling water within MODU mud pits that is no longer required will be diverted overboard at the end of the activity.	Daily mud report	Drilling Manager
19		If dry bulks (such as barite and bentonite) are unused, at the end of the drilling where feasible the stock will be: ● Retained for use on the next well or JSE campaign, this may involve transfer of stock to another MODU or temporary storage; or	Daily mud report	Drilling Manager

		• Sold to the next operator of the MODU; or • Mixed into a slurry and discharged overboard if the above options are not feasible.		
20		Only unusable inventories of cement will be diverted overboard as a slurry	Daily report	Drilling Manager
21		Barite selected for use is compliant with API standards which includes contaminant limit concentrations. These include the following limits per kg dry weight in stock barite • Mercury (1 mg/kg) • Cadmium (3 mg/kg) • Lead (<2 mg/kg)	Daily report	Drilling Manager
22		Inventory controls in place ensure that minimal stock is brought on board without compromising the minimum stock required to manage any well control or lost circulation issues.	Daily report	Drilling Manager
23	Bulk transfer procedures	Bulk solids and liquids transferred in accordance with MODU contractor procedures to reduce the risk of a release to sea. The procedures will include the following requirements: • Certified hoses are used • Valve alignment and visual hose checks occur prior to commencing transfers • Radio communication maintained during transfers between MODU and vessel • Vessels maintain station by DP during transfer procedure	Daily report	MODU OIM

		• MODU control room monitors tank fill levels or air vents watched to detect tank overfill • One person on watch during transfers		
48	MODU Marine Operating Manual	Silos are pressure vessels controlled with PSV to prevent over pressuring and rupture of tank/ uncontrolled release of dry bulk solids	PSV register	MODU OIM
49	MODU/Vessel lifting procedures	All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility	Training records and Competency matrix	Vessel Master MODU OIM

6.5.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage drilling discharges from the MODU. The residual risk ranking for this impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Wastes stored onboard and transferred to shore for onshore treatment and disposal i.e. skip and ship cuttings	Eliminate	No	No	Drilling is a requirement of the activity and the resultant drilling discharges cannot be avoided. For the sections with a conduit to the drill rig an alternative option that was considered was the collection and shipment of the drilling discharge waste to an onshore waste facility. This method of disposal would involve containment of the cuttings and fluids onboard the MODU, the regular loading of this material onto support vessels, shipping the material to shore, testing of the drill cuttings/ fluids to determine waste classification and then trucking the material to a suitable waste disposal facility. There are several detractors to this approach, including environmental impact, safety concerns and financial considerations. An estimate of the actual financial cost of this management control was calculated to be in the order of hundreds of thousands to 1 or 2 million. This would include the need for rig modification and additional: support vessels, fuel consumption, skip and ship equipment hire, crane lifting operations, truck movements, landfill and people. As well as financial cost it also transfers the environmental risk as there would be increased pressure on landfill locations and increased risk of fuel oil spill (additional vessel movements and refuelling), and additional greenhouse gas emissions with the consumption of additional fuel (both onshore and offshore) associated with transport. There are also significant safety risks associated with handling, lifting and transporting the cuttings. Low volumes of cuttings will be generated during development well drilling (200m^3 per well), which is much lower than those associated with exploration well drilling (for example). The area of seabed surrounding the Stag facility is sandy sediment with a benthic assemblage typical of soft sediments in the surrounding areas. The area has been previously disturbed through the drilling activities occurring in the field, however the biota is not significant on an ecological scale. Studies also show that levels of contaminants (heavy metals and TPH, PAH, BEX) are all below guideline values indicating that historical discharges have not had significant impacts. The discharge of cuttings and WBM to sea for this activity will result in some cumulative impacts to the sediment in the contaminant levels but given the nature of the discharges, it is unlikely that this will result in

				significant impacts to the sediment, and the biota will likely begin to recolonise the areas soon after drilling ceases. The impacts are therefore considered to be short term and recoverable and therefore of negligible impact.
Reduce toxicity of discharges	Substitute	No	No	The preferred mud system for use is synthetic based muds (SBM) as these provide a superior result from a well engineering perspective, however WBM has been selected as the option for these wells given the potential environmental impacts associated with SBM, and the wells have been designed for WBM usage. Chemicals selected for discharge during drilling are OCNS Gold, Silver, D or E to ensure that there is a low potential impact. If chemicals do not meet the OCNS requirement a risk assessment is conducted to demonstrate that no alternatives are available and that the potential environmental impact is ALARP. It is not considered feasible to require that all chemicals are selected to be the lowest potential impact only (e.g. only PLONOR and only Gold or E for example) as chemicals are required for the activity to ensure the wells are drilled safely, and the mud systems and chemicals selected must be compatible to ensure appropriate well integrity. However, by ensuring they are all acceptable for discharge, the potential environmental impacts are considered negligible and acceptable. It is noted that if chemicals have a “substitution warning”, in accordance with the Jadestone Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033), a justification for their use must be provided to ensure that adequate evaluation has been conducted and alternatives considered where feasible. Drilling brine is maintained as a contingency for well control which is PLONOR and therefore has negligible environmental impact when discharged to sea. At the end of each section a volume of unused WBM always remains. This WBM is specific for the well section and is often contaminated with drilling fines. Unless it can be conditioned for reuse it is normal oilfield practice to discharge, noting that the discharge will be of low environmental impact as chemicals are selected in accordance with the Jadestone Chemical Selection Evaluation and Approval Procedure and WBM is used. No further reduction in toxicity of discharges are therefore considered as the potential impacts are considered ALARP and acceptable.
Use of a RMR system while drilling riserless sections	Engineering	No	No	The primary benefit of RMR is the potential reduction of WBM discharged to the environment. RMR returns top-hole cuttings/WBM from the riserless section of the well to the MODU and provides an opportunity to recover and re-use the WBM drilling

				fluids. RMR does not reduce the volume of cuttings discharged to the sea, though it does afford the opportunity to pair this with skip and ship of cuttings if feasible. Cuttings disposal using RMR occurs from the MODU at (slightly below) sea surface, instead of directly to seabed at the wellhead. Discharging at sea surface rather than at the seabed reduces the accumulation of cuttings around the wellhead, but results in a localised reduction in water quality from increased turbidity and a larger seabed disturbance footprint from sedimentation (albeit at lower sediment concentrations). The only sections of the well that are riserless are the 16” sections, all other sections are closed loop as the riser is attached. The use of an RMR system while drilling is not possible due to the fact that Stag-50H will require an above mudline whipstock system which involves a 30” whipstock being stabbed into a 30” stub at the seabed guide, and Stag-51H will reuse the existing 30” conductor. Both these scenarios will not permit the use of an RMR system. The volume of cuttings remains the same, therefore if it was feasible, this option would need to be paired with skip and ship to result in a net environmental benefit.
Extended cuttings dump chute to below sea surface	Engineering	N/a	N/a	The use of a chute results in drilled solids (cuttings) discharged deeper in the water column, thereby potentially reducing spatial extent and turbidity plume. There are significant costs associated with engineering, fabricating and/or installing chute and potential delays if chute becomes blocked. Overall the chute does not reduce the volume of cuttings discharged.
Reinjection of cuttings downhole	Isolation	N/a	N/a	Reinjection of cuttings would reduce the potential impact of discharges to sea. However, there are no well slots available whilst the wells are producing, therefore JSE would have to either drill a dedicated reinjection well, or stop production in an existing well to convert into a dedicated reinjection well for drill cuttings and fluids. An estimate of the actual financial cost of this management control was not calculated as it is technically not feasible within permit WA-15-L and the cost and effort is considered grossly disproportionate to the environmental benefit.
N/a	Administra-tive	N/a	N/a	Maintenance management system implemented, compliance with relevant and appropriate MARPOL requirements, API standards and certified equipment ensure discharges meet regulatory requirements.

6.5.5 Acceptability Assessment

The potential impacts of drilling discharges are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	With a commitment to using only low toxicity fluids cement additives during the activities, as well as Jadestone's mitigation and management measures – including design of the well to minimise volumes of cuttings generated and mud/ cement used –a reduced risk of environmental impact is achieved. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regard to impacts from drilling discharges on sensitive receptors.
Laws and standards	Drilling discharges are compliant with MARPOL.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate. The Chemical Hazard Assessment and Risk Management (CHARM): For the use and discharge of chemicals used offshore (2017) states "If WBM are used, these wastes [returns and unpumped slurry] may be discharged, in which case, the chemicals present in the spacer, cement slurry and excess mixwater are evaluated within CHARM". By selecting chemicals in accordance with the OCNS rating, the discharges to sea are considered acceptable and standard industry practice,
Environmental context	While there are drilling discharges to sea surface immediately around the MODU, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna. Water quality and benthic impacts will be highly localised and restricted to the area surrounding the MODU and immediately around the surface hole location, respectively. The resultant potential impacts from drilling discharges made to sea surface and at seabed are expected to be minor. The Operational Area contains sandy habitats that are widely represented at a regional scale on the NWS. The level of contamination is known at the Stag facility due to the history of drilling and surveys undertaken in the area and the metal concentrations for sediment samples were below their respective ANZECC/ARMCANZ ISQG-Low and High values (where available) and changes in sediment characteristics and contamination is within 250m of the CPF. By selecting the use of WBM, OCNS rated Gold/Silver/D/E chemicals and API standard barite, the drilling discharges remain at acceptable levels of impact. The potential impacts are considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	No Management Plans identified drilling discharges such as those described above as being a threat to marine fauna or habitats. Most of the plans identify pollution and habitat modification and degradation relating to more significant (and usually unplanned) discharges to sea and therefore they were not considered relevant to these discharges. Jadestone has had regard to the representative values of the protected areas within the RISK

	EMBAs, and the respective management plans and other published information. Impacts from liquid discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.6 Physical Disturbance

6.6.1 Description of Hazard

Aspect	The MODU will need to be stabilised for the duration of the drilling activities. Stabilisation of the MODU, a jack-up rig, will involve spudding the rig (3 legs and associated spudcans in contact with the seabed). An area of approximately 800 m^2 will be disturbed during the drilling activity.

Disturbance of the benthic habitat and associated marine flora and fauna will result from:

- Mobilisation of the jack-up MODU; and
- Drilling discharges at the seabed (refer Section 6.5).

The 'spud cans' of the legs of the jack-up MODU that will anchor the rig to seafloor are estimated conservatively to have a surface area of 260 m^2 per leg, equating to a footprint of 780 m^2. The MODU move usually facilitated by three vessels will see the rig then move to its final position for drilling where the rig will be spudded (spudcans contacted with the seabed) such that the MODU can jack up above sea level; 780 m^2 of seabed will be contacted at this final positioning, likely within the previous MODU spud can depressions to minimise instability.

6.6.2 Impacts

The spudding of the MODU will disturb approximately 780 m^2 of benthic habitat within the Operational Area, which is predominantly soft sediment habitat. This will result in the mortality of flora and sessile fauna within this footprint and potentially the mortality of benthic infauna associated with the habitat. Following removal of the MODU, the soft sediment will be left indented, but will remain a viable habitat that would be expected to recolonise with benthic species within weeks to months following removal of the disturbance.

The scale of seabed disturbance due to positioning of the MODU is small in comparison to the vast size of soft substrata habitats spanning the NWS. The impacted benthic habitats and associated biota are well represented in the region and there are no known areas of sensitive habitat (e.g. corals, seagrass) within the Operational Area.

For noting, the location of the final positioning of the MODU, has been used in previous drilling campaigns for these purposes. These areas have been evaluated previously during pre-commencement seabed surveys and sensitive habitats (e.g. hard substrates supporting attached communities) have not been identified. It is therefore not expected that such habitats will be a consideration for the proposed drilling campaign and the spud cans will be positioned as close to the previous spud can impressions as possible (preferably in the same place) to minimise instability.

The proposed drilling activities will occur within a habitat critical to survival for flatback turtles (as referred to in Table 6 of the 2017 National Recovery Plan for Marine Turtles in Australia). In particular, the habitat area overlapping with the Stag Facility by flatback turtles is used for inter-nesting. As flatback females commonly lay more than once within the same nesting season, the period between nesting events is the inter-nesting interval. This time is spent primarily preparing for the next laying event. Sea turtles, including flatbacks, commonly do not feed during this time, and behaviours which conserve energy are considered to be at a premium. It is believed that many sea turtles spend the majority of the internesting interval apparently inactive on the seabed, sometimes referred to as resting, surfacing only briefly to breathe (Sperling et al., 2010).

Sperling et al. (2010) undertook a study that described diving behaviour of flatback turtles. Included in the paper is the note that the species is seldom known to dive deeper than 40 to 45 m; the authors data confirmed these depths observing flatbacks tracked to achieve maximum dive depths between 29 and 44 m.

The proposed activities that will disturb seabed and potential area for flatback inter-nesting intervals will be at a depth of 49 m. So, while the Operational Area for the activity overlaps with a 60 km inter-nesting buffer BIA from nearest flatback nesting beaches, the depth at which the activities are proposed are deeper than published maximum expected dive depths for this species. As such, the activities proposed are not expected to displace flatback individuals or result in a modification of their behaviour and the threat of the recovery plan advice will not be realised by this activity.

Overall Consequence assessment: Negligible

6.6.3 Environmental Performance

Hazard		**Physical presence (EPH-06)**		
Performance outcome		**Seabed disturbance limited to planned activities and defined locations**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
24	Seabed Study	A debris survey will be undertaken within the footprint of the proposed final rig position areas to inform final MODU position.	Debris survey report	Drilling Manager
		Study reviewed independently by MODU underwriter to verify no seabed punch through risk	Approved Seabed Study	MODU OIM

6.6.4 ALARP Assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the impacts to seabed and benthic habitats due to the physical presence of the MODU and vessels. The residual risk ranking for this impact is considered Low, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
No mooring footprint at seabed	Eliminate	No	No	The MODU and vessels must be on location to plug and abandon, and drill the proposed wells.
		Yes	Yes	No anchoring of the MODU or vessels.
Drill ship	Substitute	N/a	N/a	The use of a drill ship which maintains station using DP during the activity is not an option due to the shallow water depth.
N/a	Engineering	N/a	N/a	The use of seabed information collected during previous drilling campaigns allows positioning of the MODU such that the spudcans can sit over soft benthic habitats. This information is used in preparation of the MODU Mooring Plan.
N/a	Isolation	N/a	N/a	The drilling activities are located outside of areas supporting highly valuable benthic habitats.
N/a	Administrative	N/a	N/a	Positioning of MODU is based on survey of seabed habitat collected for previous campaigns completed at Stag.

6.6.5 Acceptability Assessment

The potential impacts of physical disturbance are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	With a commitment using seabed surveys to inform the MODU location, including positioning of the MODU over previous spud can depressions, the potential environmental impacts are considered lessened . Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regard to impacts from drilling discharges on sensitive receptors.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate.
Environmental context	While the physical disturbance to the seabed will result in some potential impacts to benthic fauna, the impact and risk assessment process indicates this will not result in significant effects to marine fauna. Benthic impacts will be highly localised and restricted to the area surrounding the MODU and immediately around the surface hole location, respectively. The resultant potential impacts from MODU positioning are expected to be minor. The Operational Area contains sandy habitats that are widely represented at a regional scale on the NWS. The potential impacts are considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	No management plans identified physical presence as described above as being a threat to marine fauna or habitats. Jadestone Energy has had regard to the representative values of the protected areas within the EMBAs, and the respective management plans and other published information. Impacts from physical presence will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.7 Interaction with Other Users

6.7.1 Description of Hazard

Aspect	The presence of the 500 m Zone (the Operational Area) creates a localised disturbance for other users of the area including commercial and recreational fishers, and shipping traffic, however the area is already marked as restricted on nautical charts and therefore is not additive for this activity.

6.7.2 Impacts

Presence of the MODU and the associated restricted zone will result in the preclusion of other users including commercial and recreational fishers, and commercial shipping traffic, of using the area for their purposes.

While commercial and recreational fishing is permitted to occur in the vicinity of the Stag facility (refer to Section 3.9 for information on State and Commonwealth fisheries permitted to operate in the vicinity of the Operational Area), the placement of the 500m restricted zone around the MODU means relevant commercial and recreational fishers are unable to work the area of the restricted zones.

Despite the imposition to commercial and recreational fishers due to the restricted zone, commercial and recreational fishing effort is not anticipated within these areas as they do not represent important habitat for targeted species, such as natural seabed features (e.g. rocky outcrops or coral reef). In addition, the Stag Facility, has been occupied with a production platform for 20 years and has not interrupted commercial and recreational fishing efforts.

Consequently, the Operational Area for the proposed drilling activities does not support significant fishing activity and therefore impact to fishers is predicted to be minimal to none. Any impacts to commercial or recreational fishing would not be expected to have a significant effect on the catches or income of fishers given the durations proposed. No feedback during consultation of relevant persons, including commercial fishers, was received indicating that impact to commercial fishers has or will result from the MODU being on location for completion of the drilling activities.

The presence of the MODU 500 m restricted zone, and the movement of support vessels, present obstacles for shipping traffic in the region and are potential navigational hazards and a collision risk. The MODU will be located at least 4 km away of the nearest designated shipping route and so it is not anticipated there will be high commercial shipping traffic in the immediate area that will be affected (refer to Section 3.9.4 and Figure 3-20 for details on commercial shipping, including designated shipping routes) (AMSA, 2012). Any detour by shipping traffic that may occur is considered negligible in comparison to the area available for vessels to navigate through.

For noting, the MODU will be closely associated with the Stag CPF and within the exclusion zone of the existing facility. This structure has been present and operating for 20 years, with the required exclusion zone in place. It is considered extremely unlikely that other users in the area will be impacted in any way by the presence of the MODU or the support vessels and no cumulative impacts from the MODU being within the same exclusion zone as the CPF are expected.

Overall Consequence assessment: Negligible

6.7.3 Environmental Performance

Aspect		**Interaction with other users (EPH-07)**		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
25	Stag Marine Facility Operating Manual (GF-90-MN-G-00038)	AMSA hydrographic charts: Stag Facility is marked on relevant Aus-Charts	Daily vessel report	Vessel Master MODU OIM
1	Consultation for Environmental Approvals procedure (JS-70-PR-I-00034)	Relevant persons identified according to current Regulatory requirements	Consultation records	General Manager
2		Relevant persons provided a minimum 4-week period to respond to proposed planned activities		
3		If there is a potential change in the risks or impacts to relevant persons due to planned activities relevant persons are to be consulted prior to the activity commencing		
4		Relevant persons provided information 4 weeks prior to commencement of activities to provide a specified timeframe and assets that will be present for the drilling activities including commercial fishing license holders		

6.7.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to reduce as far as practicable the imposition due to the physical presence of the MODU to activities undertaken by relevant persons in the area. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated, no further controls are required. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Removal of MODU	Eliminate	No	No	To not be physically present is not an option. Without further drilling activities, the viability of continued production at the Stag facility will be compromised.
Drill from the CPF instead of MODU	Substitute	No	No	The drilling activity cannot feasibly all be undertaken using the hydraulic workover unit at the CPF, a MODU is required to complete the full P&A and drilling activity.
None identified	Engineering	N/A	N/A	The drilling activities are located outside of shipping fairways and is not positioned in highly prized fishing habitat.
N/a	Isolation	N/A	N/A	
Additional activity specific navigational or communications requirements	Administrative	No	No	The MODU navigational management and monitoring measures in place are industry standard and internationally accepted measures to minimise the potential for interference with, or collision between, vessels. Frequent and informative communication with relevant persons regarding activities associated with the MODU location and movement will occur. Additional procedures would provide no further benefit.

6.7.5 Acceptability Assessment

The potential impacts of the MODU and associated drilling activities on other users are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices at the MODU to reflect the requirements of relevant persons.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts of the MODU on relevant persons.
Laws and standards	The MODU will be charted on Australian Hydrographic Service (AHS) nautical charts, and navigation and communication equipment is in place and operable on the assets, as per AMSA's requirements.
Industry best practice	Stakeholders have been provided information on the intended location and timing of the drilling activities and the MODU will be indicated on AMSA Aus Charts.
Environmental context	While the MODU will present a restricted zone to other users, the impact and risk assessment process indicates that the area of restriction is localised and occurs at a location that is not likely to result in significant penalties to the activities of relevant persons currently active in the area. The potential impact is considered acceptable after consideration of principles of ESD.
Conservation and management advice	No management plans identified physical presence as described above as being a threat to other users. Jadestone Energy has had regard to the representative values of the protected areas within the EMBAs, and the respective management plans and other published information. Impacts from physical presence will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

6.8 Spill Response Activities

6.8.1 Description of Hazard

Aspect	In the event of a hydrocarbon spill, contingency spill response activities will be undertaken to reduce the level of impact to sensitive receptors. Section 7.5.7 outlines the spill response strategies that will be employed in the event of a hydrocarbon spill during the drilling activities. Response strategies that may be used include: ● Source control; ● Operational monitoring; ● Surface chemical dispersants; ● Containment and recovery; ● Protection and deflection; ● Shoreline clean-up; ● Oiled wildlife response; and ● Scientific monitoring. While the aim of responding is to reduce impacts from the spill, there is the potential for response activities to exacerbate or create additional impacts if not planned and managed.

6.8.2 Impacts

The OPEP provides detail on how response strategies will be implemented.

<u>Light emissions</u>

Spill response activities will use vessels, which are required at a minimum to display navigational lighting and have night safety lighting. Spill response activities will only occur in daylight hours, although as some vessels may be moored overnight there is limited potential for night light spill from vessels to impact marine and coastal fauna habitats.

Lighting may cause behavioural changes to fish, birds and marine turtles which can have a heightened consequence during sensitive life-cycle activities (refer Section 6.1.2); for example; turtle nesting and hatching. Turtles and birds, which include threatened and migratory fauna (refer Section 3.6), have been identified as key fauna susceptible to lighting impacts. These species are also identified as KPIs in the protected areas within the EMBA (Table 3-3).

Spill response activities may occur on shorelines used by nesting turtles, including flatback, hawksbill, green and loggerhead turtles. Locations particularly important for seasonal turtle nesting include the Lowendal and Montebello Islands, Barrow Island, Dampier Archipelago and Eighty Mile Beach. The Muiron Islands and Ningaloo World Heritage area are also important for seasonal turtle nesting. Light has been identified as a key threat to turtles in the National Recovery Plan (CoA 2017a), and respective species Conservation advice. Although as shoreline spill response operations will only occur in daylight hours, there will be no impact from light.

There are 8 EPBC listed bird species whose BIA occur in the EMBA (Table 3-4). Locations particularly important for seabirds and shorebirds include Lowendal and Montebello Islands, Dampier Archipelago, and Eighty Mile Beach. Eighty Mile Beach is a particularly important area for seasonal aggregations of migratory shorebirds and is a listed Ramsar site. Ningaloo World Heritage Area and Clerke Reef (Rowley Shoals) are also important for seabirds and shorebirds. Light emissions are not identified as a key threat to any of the EPBC threatened species (**Table 3-3**). As shoreline spill response operations will only occur in daylight hours, there will be no impact from light.

Lighting impacts to fauna during spill response activities are unlikely to cause flow on impacts to reliant industries such as tourism.

Noise

Spill response activities will involve the use of aircraft and vessels which will generate noise both offshore and in proximity to sensitive receptors in coastal areas. Spill response activities will also involve the use of equipment on coastal areas during clean-up of shorelines and scientific monitoring (e.g. pumps, generators and vehicles), and for accessing shoreline areas (e.g. vehicles).

Underwater noise from the operation of vessels may impact marine fauna, such as fish, marine reptiles and marine mammals more likely causing behavioural changes which may impact key life-cycle processes (e.g. spawning, breeding, calving). Underwater noise can also mask communication or echolocation used by cetaceans. Spill response activities using vessels generating noise have the potential to impact migratory marine fauna including species who have BIAs within the EMBA such as whale sharks, and humpback and blue whales. Section 6.2 provides further detail on these potential impacts.

Noise and vibration from terrestrial activities on shorelines has the potential to cause behavioural disturbance to coastal fauna including protected and migratory species of shorebirds and seabirds. Noise and vibration may affect bird breeding and nesting behaviours and disrupt feeding activity. This could impact reproductive success and for migratory shorebirds may impact the ability to replenish energy reserves for migratory flights. However, if the shoreline is oiled, this may be beneficial by acting as a deterrent for coastal fauna and prevent oiling.

There are 7 EPBC bird species whose BIA overlaps the EMBA (refer Table 3-3). Locations particularly important for seabirds and shorebirds include Lowendal and Montebello Islands, Dampier Archipelago and Eighty Mile Beach (where birds are identified as a KPI). Eighty Mile Beach and Clerke Reef are particularly important areas for seasonal aggregations of migratory shorebirds and the former is a Ramsar site.

Noise impacts to fauna during spill response activities are unlikely to be significant enough to also cause flow on impacts to reliant industries such as tourism and commercial fishing.

Atmospheric emissions

The use of fuels to power vessel engines, generators and mobile equipment used during spill response activities will result in 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). Emissions will result in a localised decrease in air quality. Section 6.3.2 provides more detail on associated potential impacts.

Atmospheric emissions from spill response equipment will be localised and while there is potential for fauna and flora impacts, the use of mobile equipment, vessels and vehicles is not considered to create emissions on a scale where noticeable impacts would be predicted. Emissions may occur in Protected Areas and/ or areas where tourism is important however the scale of the impact relative due to atmospheric emissions discharges associated with response activities compared to potential impacts due to untreated oil spill impacts is not considered great and a net benefit can be identified.

Operational discharges and waste

Operational discharges include those routine discharges from vessels used during spill response which may include:

1. Bilge water;
2. Deck drainage;
3. Putrescible waste and sewage; and
4. Cooling water from operation of engines.

In addition, there are specific spill response discharges and waste creation that may occur, including:

5. Decanting oily water in offshore containment and recovery operations;

6. Cleaning of oily equipment/vessels and vehicles;
7. Flushing water for the cleaning of shoreline habitats;
8. Sewage/putrescible and municipal waste at camp areas; and
9. Creation, storage and transport of oily waste and contaminated organics.

Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, temperature and salinity increases as detailed in Section 6.4. Discharges may impact a different set of receptors than previously described, given vessel use may occur in shallower coastal waters during spill response activities. Discharge could occur adjacent to marine habitats for example such as corals, seagrass, macroalgae, however discharges will be very localised and temporary.

The decanting of oily water back into the marine environment during containment and recovery activities has the potential to impact marine organisms from the toxic effects from hydrocarbons, however, given the marine environment is already contaminated with hydrocarbons there is limited potential for an increase in impact, unless the discharge spreads the contamination to a previously uncontaminated area.

Cleaning of oil contaminated equipment, vehicles and vessels, has the potential to spread oil from contaminated areas to those areas not impacted by a spill, potentially spreading the impact area and moving oil into a more sensitive environment.

Flushing of oil from shoreline habitats is a clean-up technique designed to remove oil from the receptor that has been oiled and remobilise back into the marine environment and result in further dispersion of the oil. The process of flushing has the potential to physically damage shoreline receptors such as mangroves and rocky shoreline communities, increase levels of erosion, and create an additional, and potentially higher, level of impact than if the habitat was left to bio-remediate.

Sewage, putrescible and municipal waste will be generated from onshore activities which may include toilet and washing facilities. These wastes have the potential to attract fauna, impact habitats, flora and fauna and reduce the aesthetic value the environment areas. The creation, storage and transport of oily waste and contaminated organics has the potential to spread impacts of oil to areas, habitats and fauna not previously contaminated. The risk of sewage, putrescible and municipal waste is heighted in areas supporting shorebird population where shoreline staging areas may be deployed. Eighty Mile Beach is an area where large-scale shoreline response could occur and is a Ramsar listed site for migratory shorebirds.

<u>Physical presence and disturbance</u>

The movement and operation of vessels, vehicles, personnel and equipment during spill response activities has the potential to disturb the physical environment, marine/ coastal habitats and fauna, and may also impact cultural and heritage values of an area (refer Sections 6.6 and 7.2). The movement of vessels could introduce invasive marine species attached as biofouling or included within ballast water to nearshore areas, while vehicle and equipment movement could spread non-indigenous flora and fauna (refer Section 7.1).

Oiled wildlife response activities may involve deliberate disturbance (hazing), capture, handling, cleaning, rehabilitation and release of wildlife, which could lead to additional impacts to species including EPBC listed species.

The use of vessels may disturb benthic habitats in coastal waters e.g. corals, seagrass and macroalgae, including those within protected areas. Potential impacts to habitats from shoreline/ nearshore activities includes the deployment of anchor/ chain and the grounding of vessels in shallow waters. Booms create a physical barrier on surface waters which can entangle or prevent the passing of marine fauna using surface waters. Vessel use in shallow coastal waters also increases the chance of contact or behavioural disturbance of marine megafauna including EPBC listed species such as turtles, dolphins, dugongs and seabirds. Increased vessel activity further offshore has the potential to disturb migrating humpback whales, whale sharks and blue whales in season. Locations at risk are Lowendal and Montebello Islands, Barrow Island, Dampier Archipelago and Eighty Mile Beach due to high density/ diversity of benthic habitats (e.g. corals, seagrass and/ or macroalgae) and high abundance of marine megafauna using these habitats (e.g. feeding turtles, dugongs and dolphins).

Vehicles, equipment and personnel used during shoreline response activities have the potential to damage coastal habitats such as dune vegetation, samphire and mangroves and habitats important to threatened and migratory fauna including nests of turtles and birds and bird roosting/ feeding areas. Shoreline clean-up may involve the physical removal of substrates that could cause impact to habitats and coastal hydrodynamics and alter erosion/ accretion rates. Aside from physical damage to important coastal habitat (e.g. mangroves) and turtle/ bird nesting areas, the operation of vehicles, equipment and personnel can create behavioural disturbance to coastal fauna, particularly birds, which may be present and abundant during daytime operations. As discussed with lighting and noise impacts, disturbance from shoreline operations may affect nesting and feeding behaviours, negatively influencing breeding participation/success or altering migratory behaviours. The disturbance to shorebird feeding may have implications on the replenishment of energy reserves and the timing and success of migratory flights. Although, if the shorelines are oiled, this may have a beneficial hazing effect.

Sensitive mangroves areas are a key feature of the Lowendal and Montebello Islands, Dampier Archipelago and Eighty Mile Beach, while locations particularly important for seabirds or shorebirds include Lowendal and Montebello Islands, Dampier Archipelago and Eighty Mile Beach.

Aside from disturbance to habitats and marine/coastal fauna, spill response activities may create disturbance to cultural values additional to the spill itself. Shorelines of Dampier Archipelago (Burrup Peninsula) have indigenous significance in terms of traditional use for food resources as well as containing symbolic sites and landscapes. Some shorelines of the Dampier Peninsula are subject to Native Title.

Oiled wildlife response may include the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling such as birds and marine turtles. While oiled wildlife response is aimed at having a net benefit, poor response can potentially create additional stress and exacerbate impacts from oiling, interfering with key life-cycle processes, hampering recovery and in the worst instance increasing levels of mortality.

Impacts from invasive marine species released from vessel biofouling include out-competition, predation and interference with other ecosystem processes. The ability for a non-native species to establish is generally mitigated in deeper offshore waters where the depth, temperature, light availability and habitat diversity is not generally conducive to supporting reproduction and persistence of the invasive species. However, in shallow coastal areas, such as areas where vessel-based spill response activities may take place, conditions are likely to be more favourable. Impacts from invasive terrestrial species are similar in that the invasive species can out-compete local species (e.g. weeds) and interfere with ecosystem processes. Non-native species may be transported attached to equipment, vehicles and clothing. Such an introduction would be especially detrimental to wilderness areas or protected terrestrial reserves which have a relatively undisturbed flora and fauna community.

Disruption to other users of marine and coastal areas and townships

Spill response activities may involve the use of vessels, equipment and vehicles in areas used by the general public or industry. The mobilisation of spill response personnel into an affected area may also place increased demands on local accommodation and other businesses.

Shoreline response activities will restrict access and activities along affected shorelines which may include areas popular for tourism. Fisheries and aquaculture activities (e.g. pearl farming) may also be suspended in areas potentially affected by oil without necessarily being contacted by oil. Tourism and fisheries may be important economic drivers for the economies of local townships. Townships may also be impacted through the influx of spill responders using facilities for accommodation and forward operations areas which may negatively impact local businesses.

Chemical dispersant application

While the aim of chemical dispersants is to provide a net benefit to the environment, the use of dispersants has the potential to increase exposure to habitats under the sea surface, including coral, seagrass and macroalgae, and to marine fauna (particularly fish and invertebrates) by increasing entrained oil concentration. These receptors are generally located in shallow coastal areas of the mainland and offshore islands.

Increased entrained and aromatic hydrocarbon concentration can contact marine fauna, and are most likely to be encountered by plankton, benthic filter feeding invertebrates, fish and sharks. Fish and sharks include threatened/migratory species, which may ingest oil or uptake toxic compounds across gill structures. As a result of increased exposure to marine fauna and subtidal habitats, socio-economic impacts may be felt through industries such as tourism and commercial fishing.

A description of the potential impacts from entrained oil and aromatic hydrocarbons from a maximum credible worst-case spill is provided in Section 7.5.4 and Table 7-8.

Detailed assay information of Stag crude oil has been provided to APASA to commission a report, the *Net Environmental Benefit Analysis for the Use of Dispersants* (APASA, 2012c), to assess whether the application of chemical dispersants reduced the probability of contact to shorelines. Key findings of this report include a reduction in the predicted probabilities for shoreline contact, and greater prediction times to sensitive locations following the application of chemical dispersant, particularly effective during the summer months. These key findings support the use of chemical dispersants on Stag crude as they have potential to reduce hydrocarbon contact to sensitive locations, and also increase the time of the hydrocarbon contact to shorelines, thus giving time for other response strategies to take effect and further reduce impacts.

Jadestone commissioned RPS APASA to re-analyse the outcomes of a quantitative spill risk assessment for hydrocarbon spill scenarios at Stag and conduct modelling to assess the effects of hydrocarbon dispersant application (applied as per Jadestone's proposed Chemical Dispersant Plan in Section 10 of the OPEP) for the worst-case scenario (APASA, 2017).

The modelling results suggest oil loading at the closest onshore receptors, may be reduced through the surface application of chemical dispersants particularly in the summer months. The application of chemical dispersants was predicted to result in a localised increase in the concentration of entrained oil above the impact threshold of 500 ppb, particularly at the Montebello and Lowendal Islands in summer.

During a response, the area over which entrained oil will increase will be a function of the area treated with aerial dispersants. The area treated will be a function of the height at which the dispersants were dropped as well as the volume released and the speed at which the aircraft was moving at the time of release, therefore this estimated area is very much estimated and is expected to be in the order of tens to hundreds of metres. The increase in entrained oil concentration will be short term (minutes to hours) as the floating oil moves into the water column after which dispersion of the entrained oil will see concentrations decrease.

Table 6-4 provides a summary evaluation of the selected strategies performance outcomes and controls, and the benefit that will be provided in applying this strategy.

Overall Consequence assessment: Negligible

Table 6-4: Summary evaluation of selected strategies performance outcomes and controls, and associated benefit

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
Overall spill response				
Spill response has an overall net environmental benefit	Spill response activities selected on basis of a Net Environmental Benefit Analysis (NEBA) (OSRA – JS-70-PLN-I-00037)	Ensures the selection of spill response activities is having an overall net benefit to the environment	Adopt	Considered a standard spill response control
	Implementation of the OPEP	Ensures the selection of spill response activities are implemented to reduce the potential impact to the environment to ALARP	Adopt	Considered a standard spill response control
	Competency and Training Management System (JS-60-PR-Q-00014) [3]	Ensures spill response activities are undertaken by competent personnel	Adopt	Considered a standard control
	DoT and DBCA consulted with on shoreline operations location(s) in State waters as per Section 4	Prevents additional impacts to shoreline locations and fauna	Adopt	Considered a standard control
	Response operations conducted during daylight hours only	Reduces potential for behavioural disturbance	Adopt	Accepted on safety, operational effectiveness and environmental grounds.
	Waste Management Plan – Oil Spill Response Support (JS-70-PR-I-00037)	Prevents secondary contamination and litter	Adopt	Considered a standard control
Light emissions				
Light spill onto shorelines and coastal waters is reduced to ALARP during	Response vessels stand-off at night with lighting required for safety only	Reduces potential for behavioural disturbance	Adopt	Accepted on safety, operational effectiveness and environmental grounds.
	Review vessel lighting to a type (colour)	Reduces potential for	Reject	Not required given vessel restrictions at

[3] The Competency and Training Management System outlines the framework and requirements for maintaining staff competency and training specifications for Jadestone. It provides an overview of the requirements for staff and contractors to meet their training obligations and the context within which the system operates.

spill response	that will reduce impacts to fauna	behavioural disturbance		night High cost associated with change-out of vessel lighting Time delay in spill response
	Review shoreline lighting to a type (colour) that will reduce impacts to fauna	Reduces potential for behavioural disturbance	Reject	Response operations conducted during daylight hours only
Noise				
Noise emissions reduced to ALARP during spill response	Support vessel and aircraft compliance with EPBC Act Regulation 8 (cetacean interactions) (Stag Marine Facility Operating Manual GF-90-MN-G-00038, Aviation Procedure JS-83-PR-G-00010)	Reduces potential for behavioural disturbance to cetaceans	Adopt	A standard control (regulatory requirement)
	Use of noise reduction barriers for portable equipment on shorelines	Reduces sound level	Reject	Sound levels from portable equipment not expected to warrant additional costs and potential delays related to applying specialised sound control barriers
Atmospheric emissions				
Spill response vessel emissions meet MARPOL requirements	If required under MARPOL, Vessels will maintain a current International Air Pollution Prevention (IAPP) Certificate.	Reduces level of air quality impacts	Adopt – must accept this regulatory requirement	Considered a standard control (regulatory requirement) – given low impact of atmospheric emissions further control evaluation not deemed necessary.
Operational discharges and waste				
Impacts from spill response operational discharges are reduced to ALARP	Deck cleaning products released to sea are non- hazardous, readily biodegradable and non-bio-accumulative.	Reduces potential toxicity impacts to marine organisms	Reject	Vessel owners and operators are responsible for their own operational products
	Vessels meet applicable MARPOL and Marine Park sewage disposal	Reduces water quality impacts in nearshore environment	Adopt	Considered a standard control (regulatory requirement)

	requirements			
	Vessel meet applicable MARPOL requirements for oily water (bilge) discharges	Reduces water quality impacts in nearshore environment	Adopt	Considered a standard control (regulatory requirement)
	Zero bilge discharge policy	Reduces water quality impacts anywhere from bilge water	Reject	Given regulatory requirements exist to protect nearshore locations, zero discharge may potentially delay or interrupt vessel mobilisation/activity for negligible benefit
Prevention of secondary contamination of oily waste and litter during spill response	Compliance with controlled waste and disposal regulations	Prevents secondary contamination from oil waste	Adopt	Considered a standard control (regulatory requirement)
	Municipal waste containers present onsite	Prevents litter	Adopt	Considered a standard control
Physical presence and disturbance				
Disturbance to habitats, fauna and culturally sensitive areas during spill response is reduced to ALARP	Use airborne vehicle deployment (helicopters) where onshore access not feasible	Reduce coastal habitat and fauna disturbance	Reject	High costs, logistical constraints and high safety risk Landing barges will be utilised where possible
	Interstate and International vessels comply with the Marine Biosecurity Manual (JS-70-MN-G-00001)	Reduce risk for introduction of invasive marine species as part of vessel biofouling	Adopt	Considered a standard control
	Locally sourced vessels comply with Vessels comply with the Marine Biosecurity Manual (JS-70-MN-G-00001)	Small reduction in IMS risk given most vessels are local and already operate in the region Greatest risk is international and interstate vessels	Reject	Minimal benefit in terms of risk reduction is outweighed by the delays in implementing compliance checks over the many local vessels that would be required to mobilise rapidly.
	Ballast water management plan review requirement for interstate and international vessels (only)	Improve water quality discharge to marine environment to ALARP Reduce risk of introduced marine species	Adopt	Considered a standard control Vessels likely to be sourced from within WA waters

Oiled Wildlife Response				
Additional impacts from oiled wildlife response are reduced to ALARP	Implement WA Oiled Wildlife Response Plan and Regional Oiled Wildlife Response Plans	Reduce unnecessary disturbance and stress to wildlife from hazing, capture, handling, cleaning, rehabilitation, release and euthanasia	Adopt	Considered a standard control
Disruption to other users of marine and coastal area and townships				
Reduce and control disruption to other users of marine and coastal areas and townships during spill response is reduced to ALARP	Stakeholder consultation (Refer Section 4)	Early awareness of spill response activities which reduces potential disruption	Adopt	Considered a standard control
	Localised Risk Management Assessment to be conducted if the response is of significant size in comparison to the size of the coastal community	Reduces potential impact due to higher utility demands causing disruptions to local community	Adopt	Considered a standard control
Chemical dispersant application				
Additional impacts from dispersant application are reduced to ALARP	Chemical dispersant selected after having been risk assessed through Jadestone Chemical Selection, Evaluation and Approval Procedure (JS-70-PR-I-00033) The evaluation must find the chemical acceptable for use prior to application.	Reduce impacts on fauna / flora from toxicity of the dispersant	Adopt	A standard procedure Jadestone Chemical Selection, Evaluation and Approval Procedure (JS-70-PR-I-00033) used for chemical selection
	Operational monitoring of oil and oil in water during dispersant application	Provides information to inform NEBA analysis	Adopt	Considered a standard control
	No dispersant application	Prevents any potential impacts from dispersant or chemically dispersed oil	Reject	Dispersant modelling indicates that dispersant has the potential to reduce shoreline loading and spatial extent of oil in some scenarios. Therefore, it is better to have in the toolbox and decision for application will be subject to the NEBA.

6.8.3 Environmental Performance

The OPEP contains environmental performance measures for the spill responses, this table outlines the spill response preparedness measures only.

Hazard		Oil Spill Response Activities (EPH-10)		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
	Overall spill response			
	Spill response preparedness			
26	Contracts valid and maintained in accordance with Jadestone Energy Contractor Management Framework (JS-90-PR-G-00002) to ensure access to competent personnel and appropriate equipment	Contracts in place and current with competent providers and suppliers	Contractor assessment records	Supply Chain Manager
		Vessel crew qualified in accordance with International Convention of Standards of Training, Certification and Watch-keeping for Seafarers (STCW95)	Records of crew certificates or third-party inspection document	Supply Chain Lead
27	AMOSC MSC/AMSA MOU valid for life of the EP	AMOSC membership allowing access to mutual aid arrangements for spill response crew and equipment via a Master Services Contract (MSC) AMSA MOU (access to NRT and resources)	Current AMOSC membership and MSC AMSA MOU valid for 5 years from 2017	Country Manager
28	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Assessment of response personnel as being competent and trained according to the requirements of Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Response personnel competency and training records	HR Manager
		Implement the Incident Management Team Response Plan in the event of a spill of hydrocarbons to the marine environment	Incident log	IMT Lead
29	Jadestone Energy Audit Manual (JS-90-PR-G-00003) includes emergency response and spill	Audit of Jadestone's emergency response and spill preparedness requirements as scheduled	Audit schedule Audit reports	ER Lead

	preparedness			
30	OPEP maintained to ensure spill response is appropriate to nature and scale of risk	Spill response planning and preparedness aligned with nature and scale of risk. In the event of a Level 2 or Level 3 spill, compliance with OPEP including develop and implement an IAP using the processes described within the OPEP.	Stag OPEP Response records confirm OPEP was adhered to and an IAP was developed and implemented.	ER Lead
31	Shipboard Oil Pollution Emergency Plan valid and tested to ensure ability to respond to spills as required by MARPOL	In line with MARPOL Annex 1, vessels over 400 gross tonnage will have a current Shipboard Oil Pollution Emergency Plan (SOPEP)/ Shipboard Marine Pollution Emergency Plan (SMPEP) and International Oil Pollution Prevention (IOPP) certificate	Current SOPEP and exercise schedule	Operations Manager
32		Spill exercises are conducted in accordance with the SOPEP		
33	Personnel aware of roles and responsibilities in the event of a response in accordance with Stag Incident Response Plan (GF-00-PR-F-00041)	Instructs offshore response roles and responsibilities and training requirements.	Training and induction records	Stag OIM
		Spill exercises conducted as part of incident response drills.	Exercise records	Stag OIM Vessel Masters OIM
34	Labour hire contract in place for life of EP to source labour for spill response	Labour hire contract in place to provide access to personnel	Labour hire contract	HR Manager
35	Vessel availability for containment and recovery activity is monitored monthly via Jadestone's nominated vessel broker	Monitor the availability of vessels that are suitable for deployment of the Containment and Recovery strategy as defined in the OPEP	Monthly monitoring reports	Supply Chain Management
36	Maintain contract with Jadestone's Waste Management Contractor for life of the EP	Waste management contract is maintained which enables access to waste storage facilities and waste transport	Contractor assessment records	Logistics Lead
37	Maintain contract with scientific monitoring service provider for	Scientific monitoring services contract is maintained which enables access to competent personnel to undertake scientific monitoring	Contract valid and current	ER Lead

38	life of the EP	Scientific monitoring services provider participates in a Jadestone annual exercise for a spill response scenario	Emergency exercise evaluation report	ER Lead
39	Scientific monitoring plan reviews	12 monthly review of SMPs post OPEP exercise Six monthly external legislative review of environmental matters to ensure currency of information Annual audit of capability and readiness as described in the Scientific Monitoring Implementation Plan and SMP Framework is conducted by Jadestone	Audit Manual (JS-90-PR-G-00003) Notification of membership Contract with external environmental consultancy	ER Lead
40	Maintain contract with tracker buoy provider for life of the EP	Contract is maintained which enables access to tracking buoy services	Contract valid and current	ER Lead

6.8.4 ALARP Assessment

The purpose of implementing spill response activities is to reduce the severity of impacts from an oil spill to the environment. However, if the strategies do more harm than good (i.e. they are not having a net environmental benefit) then the spill response is not ALARP. The key process in determining if the strategies employed are having a net benefit is the net environmental benefit analysis (NEBA). A NEBA is conducted for each operational period during a response to ensure the best strategies are being implemented and the ALARP principle is regularly tested (refer to the OPEP for further detail**).**

It is best practice to ensure all possible response strategies have been evaluated and, if there is the potential to produce a net environmental benefit, to have them in the toolbox ready for implementation if determined feasible for the scenario, (IPIECA (2016) Contingency planning for oil spill on water: Good practice guidelines for the development of an effective spill response capability).

For each of the environmental hazards associated with spill response strategies an ALARP evaluation was conducted as part of the hazard identification workshop. A number of controls were identified as industry and/ or Jadestone standard controls that will be considered during a spill response while additional controls were evaluated and either accepted or rejected on the basis of the ALARP principal, i.e. a decision was based on whether the additional control would have a cost/ effort disproportionate to the level of impact reduction it would provide. Results of the evaluation are shown in Table 7-11 and reflected in Section 7.5.7.

Note that some of the potential impacts to fauna from spill response activities can be beneficial in the prevention of oiling by acting as deterrents. For example, if shoreline operations are being undertaken at a turtle nesting or bird breeding site, fauna may avoid the location as disturbed by noise or people and thereby not be oiled.

6.8.5 Acceptability Assessment

The potential impacts of spill response activities are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone’s HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone’s HSE Management System is capable of continuously reviewing and updating activities and practices at the Stag facility, including spill response arrangements.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), including engagement with the State and National response agencies of DoT and AMSA, nearby operators, AMOSC, as well as commercial and recreational fishing industry bodies and fishers. No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Laws and standards	Jadestone is obligated to respond to a hydrocarbon spill under the following legislative instruments: ● OPGGS Act Section 572A-F – polluter pays for escape of petroleum ● AMSA Marine Orders Part 91 ● Protection of the Sea (Prevention of Pollution from Ships) Act 1983 ● Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008
Industry best practice	Response planning and preparedness undertaken in accordance with: ● National Plan for Maritime Environmental Emergencies (AMSA, 2020) ● AMOSPlan (AMOSC, 2017)

	• NOPSEMA Guidance Notes (e.g. Oil Pollution Risk Management Guidance Note July 2021)
	• DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangement July 2020
	• State Hazard Plan – Maritime Environmental Emergencies (MEE) (2021)
	• Fingas, M.F. (2012) The Basics of Oil Spill Clean-up. CRC Press. Florida, United States of America.
	• ITOPF Technical Information Papers including:
	  ○ ITOPF (2014) Technical Information Paper Dispersant Use
	  ○ ITOPF (2015). ITOPF Members Handbook 2011/12
	ITOPF (2014) Technical Information Paper Clean-up of oil from shorelines
	• IPIECA International Association of Oil and Gas Producers Good Practice Guide Series including:
	  ○ IPIECA-IOGP. (2015) A Guide to Oiled Shoreline Clean-up Techniques: Good practice guidelines for incident management and emergency response personnel
	  ○ IPIECA-IOGP (2015) Oil spill preparedness and response: an introduction
	  ○ IPIECA-IOGP (2015) Contingency planning for oil spills on water Good practice guidelines for the development of an effective spill response capability
	• Oil Spill Response (OSRL) handbooks including:
	  ○ Shoreline operations handbook

Environmental context	The worst-case credible spill scenario for the activities is as a result of a loss of pipeline integrity. The release of oil modelled occurs over 30 minutes and the area of dispersion over which the oil travels is between Eighty Mile Beach to the north, and to outer Ningaloo in the south. The oil is primarily floating and sensitive receptors at risk include seabirds, shorebirds, marine fauna and coastal habitats. While some response strategies (e.g. application of chemical dispersants and booming operations) may pose additional risk to sensitive receptors, to not implement response activities would likely result in greater negative impact to the receiving environment and a longer recovery period. Response activities are undertaken in accordance with controls which reduce and/or prevent additional risks. The mutual interests of responding and protecting sensitive receptors from further impact due to response activities is managed through the use of a net environmental benefit analysis during response strategy planning in preparedness arrangements as well as during a response. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	Jadestone Energy will have regard to the representative values of the reserves and other information published and endeavour to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state MPs impacted by spill response activities to ensure that the objectives of the management plans are not contravened. Noting 'Emergency response' is permitted in all AMPs and State MPs. Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorised under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian MP and, so far as reasonably practicable, prior to a response action being taken within a MP. The Management Plans for EPBC protected species that identify light, noise and other risks through Sections 6.1 – 6.6 apply here.

	The ‘Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species’ will be applied/used as guidance in the event of an oil spill.
ALARP	The residual risk has been demonstrated to be ALARP.

7. ASSESSMENT – UNPLANNED EVENTS

This section of the EP describes the potential risks and environmental impacts from accidental events that may arise during the drilling activities within permit WA-15-L, and associated mitigation and management measures that will be implemented to reduce risks and impacts to as low as reasonably practicable and acceptable levels.

The environmental risk assessment process identified six accidental environmental risks. The residual risk rankings are summarised in Table 7-1 and presented in detail throughout this section.

Table 7-1: Summary of the environmental risk assessment ranking for unplanned events

Unplanned activities	***Consequence***	***Likelihood***	***Residual Ranking***
1. Marine pest introduction	Moderate	Unlikely	Medium
2. Interaction with Fauna	Minor	Unlikely	Low
3. Unplanned release of solids	Minor	Unlikely	Low
4. Unplanned release of Non-hydrocarbon liquids	Minor	Unlikely	Low
5. Unplanned release of Stag Crude	Major	Unlikely	Medium
6. Unplanned release of Marine diesel	Minor	Unlikely	Low

The presentation of impacts and risks identified during the assessment process for hazards associated with unplanned activities is provided as follows:

- Description of the hazard;
- Impacts and risks – a discussion and assessment of the environmental impacts and risks associated with accidental events that may arise;
- Environmental performance – a description of a measurable level of performance required for the management of environmental aspects to ensure that the environmental impacts and risks will be ALARP and of an acceptable level; and a statement of performance required of a control measure. This includes a description of the control measures in place to reduce the impact and control the risk; and
- Demonstration of ALARP and Acceptability – a demonstration that the environmental impacts and risks will be reduced to ALARP and will be of an acceptable level, and the rationale for these statements.

7.1 Marine Pest Introduction

7.1.1 Description of hazard

Aspect	Prior to arriving in Australian waters, the MODU will be required to exchange ballast waters such that ballast water upon entering Australian waters and moving to location will be considered low risk (of introduced marine pest introduction). If from international waters, vessels may have biofouling considerations for in-water structure and apparatus.

7.1.2 Impacts and Risks

The introduction and establishment of marine pests can result in a localised impact on native marine fauna and flora, including:

- Competition, predation or displacement of native species;
- Alteration of natural ecological processes;
- Introduction of pathogens with the potential to impact human and/or ecological health;
- Reduction and/or competition with commercial fish and aquaculture species; and
- Increased requirement for maintenance of vessels and marine infrastructure.

Potential sources for the transfer and establishment of marine pests include:

- Biofouling on vessels and other external niches (e.g. propulsion units, steering gear and thruster tunnels);
- Biofouling of vessels or other internal niches (e.g. sea chests, strainers, seawater pipe work, anchor cable lockers and bilge spaces);
- Biofouling on equipment that routinely becomes immersed in water (including but not limited to equipment such as conductor casing and ROVs); and
- Discharge of high risk ballast water taken up at international or domestic sources.

There are three key steps involved for a successful Introduced Marine Pest Species (IMPS) incursion:

- Colonisation and establishment of the marine pest on a vector (e.g. vessel) in a donor region (e.g. home port);
- Survival of the organism on the vector during the voyage from the donor to the recipient region; and
- Colonisation (e.g. reproduction or dislodgement) of the recipient region by the marine pest, followed by successful establishment of a viable new population (Commonwealth Government, 2009).

Colonisation requires there to be suitable environmental conditions for the particular species, including water temperature, water depth and habitat type. As such, most exotic marine pests introduced to Australian waters have distributions restricted to shallower coastal habitats.

It is unlikely that any invasive marine pests entering the Operational Area would establish on the natural benthic habitat (soft sediments at the seabed). The depth of the Operational Area (49 m), open ocean conditions and lack of available light at this depth provides a very different environment to that within sheltered port and shallow coastal areas which have historically been colonised by invasive marine pests.

Subsequently the likelihood of a potential introduction of IMS is considered low.

Following their establishment, eradication of marine pest populations is often impossible, limiting management options to ongoing control or impact minimisation. For this reason, increased management requirements have been implemented by Commonwealth and State agencies with the implementation of Australia's National System for the Prevention and Management of Marine Pest Incursions which looks at managing biofouling and ballast water.

Ballast water

The MODU will exchange ballast water during mobilisation/ demobilisation from drilling location. The Department of Agriculture Water and Environment (DAWE) is the lead agency for management of ballast water from vessels operating in Australian waters. DAWE introduced the Australian Ballast Water Management Requirements Version 8 (DAWE 2020) that are enforced under the Biosecurity Act 2015. The requirements provide guidance for vessel operators on best practice policies and apply to all vessels operating internationally and domestically in Australia.

Key points for vessels intending to discharge ballast within Australian waters, as detailed within the Australian Ballast Water Management Requirements Version 8 include:

- All vessels must carry a valid ballast water management plan;
- All vessels must carry a valid International Ballast Water Management certificate;
- Vessels with a ballast water management system (BWMS) must carry a Type Approval Certificate specific to the type of BWMS installed; and
- All vessels must maintain a complete and accurate record of all ballast water movements.

Biofouling

Under the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), a risk assessment approach is recommended to manage biofouling.

The potential biofouling risk presented by vessels, including MODUs, relates to the length of time vessels are in Australian waters or operating outside Australian waters, the length of time spent at these location(s) and whether the vessels have undergone hull inspections, cleaning and application of new antifoulant coating prior to operating in Australian waters.

Any vessel or marine infrastructure destined for WA waters from interstate or overseas is required to meet the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*, including a Marine Biosecurity Inspection for the presence of known and potential IMS to ensure compliance with Regulation 176. No target marine species of concern to Australian waters can be observed during the in-water inspection. In accordance with marine pest management guidelines (as enforced under the WA Fish Resources Management Act 1994; and Fish Resources Management Regulations 1995):

- Immersible equipment and the vessel hull, sea chests and other niches must be 'clean' before any vessels enter WA waters and ports; and
- The suspected or confirmed presence of any marine pests or disease must be reported within 24 hours by email (Aquatic.Biosecurity@dpird.wa.gov.au) or telephone (FishWatch tel: 1800 815 507). This includes any organism listed on the WA Prevention List of Introduced Marine Pests, and any other non-indigenous organism, that demonstrates invasive characteristics.

Stag Field IMS Status

As an initial IMS risk screening and management focus measure, species listed or assessed as invasive by DAWE were considered in the context of their potential to be able to establish on the Stag infrastructure, following possible transfer to the field by ships. These candidate species were primarily drawn from those considered as presenting tangible risk via the process of development of the Australian Priority Marine Pest List (ABARES 2019). This field of candidate species was further refined, based upon work by Australian Government agencies (MPSC 2020; NIMPIS 2008; Richmond et al. 2010) by dismissing those which would require habitat conditions not available in the Stag field, with subsequent concentration upon those which could theoretically establish upon Stag and present tangible risk of further spread to Australian coastal waters.

In accordance with NOPSEMA guidance (NOPSEMA 2018), video ROV footage captured during structural assessment surveys of Stag field infrastructure in February and July 2020 was reviewed as a means of detecting any invasive species which may have established (PGM Environment, 2021). Notwithstanding the inherent limitations of in-water surveys, and the difficulties of detecting mobile species such as crabs, the review of ROV video footage did not detect any listed IMS nor indicate their likely presence (PGM Environment 2021). In general terms, the biofouling assemblage observed on the Stag field infrastructure was representative of that which would be expected of any structure immersed for an extended period in the waters in that region.

Should any IMS establish in the Stag field, other than being an isolated colony of note, they would only represent any specific biosecurity hazard to Australian waters if they were able to transfer from Stag to a nearby location of some ecological, social or economic significance and then establish in that latter location. Those locations exhibiting potential significance or vulnerability to invasion include nearby ports and conservation areas. The closest coastal areas to Stag are Dampier archipelago approximately 32km away, and the nearest marine protected areas or significant regional features are the Glomar Shoals and the Montebello Islands, which are 100km and 75 km, respectively, from Stag at their closest points. Any IMS located at Stag could only reach any of these locations following spread and dispersal by mechanisms such as currents or carriage by vessel.

Currents in the Stag field are semi-diurnal and predicted to have average speeds of approximately 0.25 knots up to 0.5 knots. The oscillating nature of the currents suggests that it would take somewhat in excess of three days, as a minimum, for floating larvae to reach the coastal locations in closest proximity to the Stag field, and somewhat longer to reach the closest conservation significant areas. Spread of IMS from the Stag field could also be conceivably accomplished by larval colonisation of vessels operating in the Stag field, or by mobile species swimming across to such a vessel, with subsequent vessel-mediated transfer to other locations. Although theoretically possible, such transfer has been reviewed and deemed to present a low likelihood of occurrence (URS 2013).

On the basis of the species risk evaluations and review of available video footage, it may be stated that the Stag field infrastructure, as at the time of the reviewed ROV surveys, presented no evidence of having been colonised by listed marine pest species of concern to DAWE, and with no indicators of likely presence. Accordingly, and within the limitations intrinsic to such surveys, it may be concluded that Stag infrastructure is unlikely to harbour IMS of concern and thus represents minimal risk as a haven or staging point for subsequent further spread of IMS (PGM Environment, 2021).

There are increased concerns regarding fishery impacts following the introduction of IMS into Australian waters. Should IMS be introduced, they have the potential to outcompete and displace native species which may in turn affect the local marine ecosystem, and potentially fisheries operating in the area affected. However, the Operational area does not contain any known critical areas (i.e. feeding, breeding) or highly significant habitat (i.e. coral reef, seagrass) for fish. It is also unlikely that IMS will be able to establish. However, if IMS were established it may have a 'moderate' impact - Local effect; recovery in months to a year; impact to localised community.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***
Moderate	Unlikely	Medium

7.1.3 Environmental Performance

Hazard		**Marine Pest Introduction (EUH-01)**		
Performance objective		**No introduction of marine pest species**		
ID	**Management controls**	**Performance standards**	Measurement criteria	Responsibility
41	Vessels and MODU comply with the Biosecurity Manual (JS-70-MN-G-00001)*	All vessels demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance with DAWE ballast water management requirements. Documented evidence of effective management of ship biofouling management, consistent with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).	Marine Superintendent
42	Vessels comply with Australian Ballast Water Management Requirements (DAWE 2020)	All vessels discharging ballast water within the Operational Area are to maintain Ballast Water Records as per DAWE (2020) requirements	Ballast Management Plans and Ballast record books	OIM/ Vessel Master

* The biosecurity manual (Submitted to NOPSEMA and Jadestone refers to its contents under Regulation 31) applies to all marine vessel operations undertaking activity In the Operational Area and has as its purpose to:

a) Describe the marine biosecurity management process for Jadestone Energy (Australia) Pty Ltd activities including vessels contracted to perform marine operations.

b) Prevent the introduction of Invasive Marine Pests (IMP) into Australian Waters and the Operational Area through translocation vectors such as marine and petroleum vessels, immersible equipment and ballast water.

c) Ensure contracted vessels and vessel operators are aware of and apply the marine biosecurity requirements when chartered to execute their scope of work.

d) Ensure compliance with Commonwealth and State Australian Government legislation.

e) Detail the risk-based approach and mitigations used to reduce the risk of IMPs being introduced to the Operational Area to As Low as Reasonably Practicable (ALARP).

7.1.4 ALARP Assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of marine pests being introduced during the drilling activities. The residual risk ranking for this potential impact is considered Medium, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
MODU/ vessels to be sourced from Australian waters	Eliminate	No	No	The presence of the MODU and associated support vessels is required to carry out drilling activities. Delays to activities caused by delays to contracting vessel(s). Minimal benefit expected given the implemented controls ensure only low IMS risk vessel are contracted.
Follow-up marine pest inspection around 75 days after arrival if the vessel is still in WA waters	Isolation	No	No	The residual risk of IMS is considered low due to inspection and cleaning controls and follow-up inspections of vessels 75 days after arrival is not considered required. In the event that any invasive marine pests entered the Operational Area the nearest habitat is the MODU/ vessel hull or the benthic habitat (soft sediments at the seabed). The anti-fouling coating, depth of the Operational Area (49 m), open ocean conditions and lack of available light at this depth provides a very hostile/ different environment to that within sheltered port and shallow coastal areas which have historically been colonised by invasive marine pests.
N/a	Substitute	N/a	N/a	Wherever possible, domestic vessels will be sourced, but this may not always be feasible. Regardless, all vessels are subject to IMS risk assessment and must manage their ballast water in accordance with regulatory requirements.
Application of new anti-foulant coating to vessels prior to contract commencement	Engineering	No	No	Substantial additional cost, potential delay to commencement of activity. Little benefit given recent anti-fouling treatment history for vessels and requirement to complete IMS Risk assessment. Anti-fouling coating on the in-water surfaces of vessels, and the chemical dosing of seachests (marine growth prevention system) will occur. Anti-fouling coatings containing TBT are not an option as these anti-foulants are prohibited for use in Australia.
N/a	Administrative	N/a	N/a	The implementation of a Biofouling Management Plan and maintaining a Biofouling Record Book consistent with the DAWR (2015) *Anti-fouling and in-water cleaning guidelines*. No further administrative controls were considered.

7.1.5 Acceptability Assessment

The potential impacts of marine pest introduction are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and their practices to reflect the requirements of marine pest management in Australian waters.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised. Jadestone will continue to liaise with Department of Fisheries on current requirements for the management of the risk of marine pest introduction in WA waters.
Laws and standards	While no legislation regulates hull/ niche biofouling, vessels associated with the activity will adopt the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).
Industry best practice	Application of guidelines detailed in the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), and in the IMO Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species.
Environmental context	It is unlikely that any invasive marine pests entering the Operational Area will establish on the natural benthic habitat (soft sediments at the seabed). The depth of the Operational Area (49 m), open ocean conditions and lack of available light at this depth provides a very different environment to that within sheltered port and shallow coastal areas which have historically been colonised by invasive marine pests. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management/ Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	Application of guidelines detailed in the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), and in the IMO Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species. Jadestone has had regard to the representative values of the protected areas within the Operational Area, and the respective management plans and other published information. Impacts from any hypothetical successful establishment of marine pests will not impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans and considered acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

7.2 Interaction with Fauna

7.2.1 Description of Hazard

Aspect	Physical presence of the MODU and the movement of vessels and helicopters may result in in fauna disturbance and injury/ death.

7.2.2 Impacts and risks

Potential impacts to marine fauna and avifauna may occur as a result of:

- The physical presence of the MODU; or
- Vessel and helicopter movements associated with drilling operations.

Potential physical and behavioural impacts may range from temporary and localised displacement to injury or mortality from vessel strike.

Impacts to marine fauna associated with noise are assessed in Section 6.2.

<u>Physical presence</u>

Species most susceptible to impacts from physical presence include turtles, birds, and cetaceans. Migratory species such as seabirds may experience localised and short term effects through behavioural changes; such as roosting on platforms, or changed feeding patterns in nearby waters in response to other factors such as attraction of fish to the infrastructure (Verhejen, 1985; Weise et al., 2001). This is predominantly attributed to the observation that structures in deeper water environments tend to aggregate marine life at all trophic levels, creating food sources and shelter for seabirds (Surman, 2002). Behavioural changes could affect the size and composition of the seabird community in the local area.

The proposed drilling activities will occur in an area identified as 'species core range' for humpback whales and it is possible that these and other whale species may transit the area during migration periods. Based on evidence outlined in Section 3.6.3, during the northern migration, individuals may be in the deeper waters while those in the southern migration tend to stay in shallower waters and so outside the Operational Area. The Operational Area is not close to any identified aggregation areas such as resting or calving locations, and is within a migration corridor ~200 km wide, so is not considered a restricted corridor. It is assessed that the MODU presence will not present a significant obstacle that will pose an issue to individuals as they will be able to easily swim around the infrastructure with minimal deviation from migratory routes.

The Operational Area is overlapped by the humpback whale migration BIA, pygmy blue whale distribution BIA, flatback turtle internesting buffer BIA and habitat critical to the survival (Table 3-4**Error! Reference source not found.**) and the foraging BIA of the whale shark is 9 km away and as such individuals may transit the area.

Slight deviations by migrating marine fauna including humpback whales, pygmy blue whales and whale sharks, to avoid the MODU may be required, however this impact is considered negligible given the large navigable area available and the relatively small Operational Area. Consequently, the presence of the MODU and associated vessels is unlikely to disrupt important life-cycle events of marine fauna as no aggregation areas are located in the vicinity and so impacts at an individual and population level are considered minimal.

<u>Vessel/ Helicopter strike</u>

There is significant vessel traffic transiting from ports to offshore waters in the North-West and so the threat of ship strikes to megafauna is present throughout the region. Fauna most susceptible to vessel strike include cetaceans, whale sharks and turtles, and this is reflected as a threat in many of the conservation advice and recovery plans for these species (refer Table 3-5). Other fauna such as birds, fish and sea snakes are more likely to avoid vessels operating in the area and so are considered at low risk of potential strike and will not be discussed further.

Cetaceans including humpback whales demonstrate a variety of behaviours in response to approaching vessels (attributed to vessel noise), including longer dive times and moving away from the vessel's path with increased speed (Baker and Herman, 1989; Meike *et al*., 2004). These behaviours (discussed in Section 6.2) may contribute to reducing the likelihood of a vessel strike.

The likelihood of vessel/ whale collision being lethal is influenced by vessel speed: the greater the speed at impact, the greater the risk of mortality (Laist *et al*. 2001, Jensen and Silber 2003). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from about 10% at 4 knots to 80% at 15 knots. Vessels within the Operational Area will travel no faster than 5 knots, and hence the chance of a vessel-whale collision resulting in lethal outcome is reduced. The US NOAA database (Jensen and Silber, 2003) indicates there are only two known instances of collisions when the vessel was travelling at less than 6 knots and both of these were from whale watching vessels that were deliberately placed amongst whales.

Although the whale shark's skin is thicker and tougher than any other shark species, the species may be more vulnerable to boat strike as they spend a significant amount of their time close to the surface of the water (DEH 2005a). The then DPaW (now DPIRD) developed a code of conduct for commercial vessels engaged in whale shark watching and these measures have been used to develop minimum requirements for support vessels in the Operational Area: vessels shall not approach closer than 400 m from a whale shark.

Given that marine turtles, particularly flatback turtles, whose internesting buffer BIA overlaps the Operational Area, are known to occur in the vicinity, there is a risk of potential vessel strike. Hazel et al. (2007) suggested that higher vessel speed is more likely to cause impacts particularly in shallow waters where turtles are abundant and the success of avoidance behaviour is a factor of the response time available (i.e. visual observation distance/ vessel speed). By implementing reduced vessel speeds to <5 knots in the Operational Area, the likelihood of a strike and the severity is greatly reduced.

Given the slow operating speed of support vessels as well as the low likelihood of large numbers of aggregating animals present, the potential for vessel strike to impact significantly on a cetacean, whale shark or turtle population in the Operational Area is assessed to be low.

Helicopter movements have the potential to affect birds through direct strike, however, considering the high visibility and noise levels associated with helicopter movements, birds are expected to avoid collisions with helicopters. The number of helicopter flights required is relatively low averaging two inward/ outward flights per week. Flights also occur in the daylight and not within major roosting areas, thereby reducing potential interactions and subsequent physiological impacts. Though it is recognised that the wedge-tailed shearwater breeding BIA overlaps the operational area, but is a very large area compared to the BIA and given the distance to the nearest breeding and roosting areas (i.e. land) is greater than 32km away, it is unlikely significant numbers will overfly the location. Collisions are therefore considered unlikely.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***
Minor	Unlikely	Low

7.2.3 Environmental Performance

Hazard		**Interaction with fauna (EPH-08)**		
Performance outcome		**No death or injury to EPBC Act listed marine fauna due to activities in the Operational Area**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
6	Vessels will comply with EPBC Regulations 8.05 and 8.06, as per Stag Marine Facility Operating Manual (GF-90-MN-G-00038)	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: - Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and - If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines, or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots. - The above requirements will also apply to whale sharks if they are sighted within 300 m of the vessel.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed by Vessel Master. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans) Induction includes whale shark avoidance requirements	Supply Chain Lead Vessel Master Drilling Manager
7	Helicopters will comply with EPBC Regulations 8.07	Helicopters will comply with the following elements of EPBC Regulations 2000 Regulation 8.07, except during take-off/ landing, during an emergency or when action is required to maintain safe operations: - A helicopter will not operate at a height lower than 1,650 ft or within a horizontal radius of 500 m of a cetacean; and - A helicopter will not deliberately approach a cetacean from head-on. Helicopter operators are required to report any instances where these standards are breached, and any event involving injury to or death of marine fauna due to helicopter operations.	Helicopter Contractor's procedures reflect EPBC regulations 8.07. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans)	Supply Chain Lead

43	Vessels operate at speeds in accordance with Stag Marine Facility Operating Manual (GF-90-MN-G-00038) to reduce potential for collision with marine fauna	Vessels operating within the restricted zone must not exceed a speed of five (5) knots.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed by Vessel Master.	Supply Chain Lead
44	Competency and Training Management System (JS-60-PR-Q-00015) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	Vessel Master
45	Marine fauna collisions reported to National Ship Strike Database	Any vessel collision with a whale in the Operational Area is submitted to the National Ship Strike Database at: https://data.marinemammals.gov.au/report/shipstrike Death or injury to EPBC Act listed marine fauna (including cetaceans or whale sharks) from vessel collision are recorded/reported to NOPSEMA and DAWE in line with regulations	Vessel collision incident report Database entry number	HSE Manager

7.2.4 ALARP Assessment

On the basis of the ERA conducted, and the use of relevant tools appropriate to the decision type, Jadestone considers the control measures described above are appropriate to manage the risk of collision between vessels and marine fauna or negative interaction with helicopters. The residual risk ranking for this impact is considered Low and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost Effective	Justification
Removal of vessels and helicopter use	Eliminate	No	No	Vessel and helicopter presence is required during drilling activities and there are no practicable alternatives. The potential for interaction between support vessels and fauna cannot be eliminated, however the risk is extremely low given the location, low volume of vessel activity and speed limits.
Reduce frequency or size of support vessels	Substitute	No	No	Reducing the frequency or size of support vessels would introduce disproportionate operational and safety risks; for example, the vessel is required to be of sufficient size and power to enable efficient and timely supply of the necessities/ services to maintain effective operation of the MODU and to mob/ de-mob the MODU.
N/a	Engineering	N/a	N/a	Not relevant
Reduce or remove vessel and helicopter use during key sensitive periods	Isolation	No	No	Reducing or removing vessel and helicopter activities during known migration periods of marine fauna is not a viable option as these activities are necessary for the safe and efficient operation of the MODU.
Use of Marine fauna observers on all vessels to identify fauna close to vessels	Administrative	N/a	N/a	Vessel Masters will complete an environmental induction which includes the applicable requirements or speed limits and avoiding fauna. The introduction of a specialist marine fauna observer is unlikely to increase detection and the additional cost is considered grossly disproportionate given the low vessel speeds and low potential for impacts on marine fauna.

7.2.5 Acceptability Assessment

The potential impacts of helicopters and vessels on marine fauna during the drilling activities are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to impacts from MODU/ vessel/ helicopter operations on sensitive receptors.
Laws and standards	Aspects of the EPBC Regulations 2000, Division 8.1 – Interacting with Cetaceans Recovery Plan for Marine Turtles in Australia, (CoA 2017a)
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate. Whale Shark Code of Conduct (DEC)
Environmental context	The Operational Area overlaps the humpback whale 'species core range', migratory BIA, the pygmy blue whale distribution BIA, is adjacent to the whale shark foraging BIA and overlaps the flatback turtle internesting buffer BIA and habitat critical to the survival. However, risk to megafauna is considered low and acceptable as vessels will travel at <5 knots; minimal vessel activity in the area, and risk of mortality from a low-speed vessel strike is low. Reference Western Australian 'Whale Shark Management with particular reference to Ningaloo Reef' Wildlife Management Program No. 57. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	**Recovery Plan for Marine Turtles in Australia, (DoEE, 2017).** The Recovery Plan for marine turtles in Australia (DoEE, 2017) identifies the following risk -Vessel Disturbance. It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Conservation Management Plan for the Blue Whale, 2015-2025.** The Management Plan identifies the following risk – 'Vessel Disturbance". It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a)** The conservation advice identifies the following risk – boat strike from large vessels. It requires that transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations (Ningaloo Reef, Christmas Island and the Coral Sea) and along the northward migration route that follows the northern Western Australian coastline along the 200 m isobath are minimised. The location of the operational area is adjacent to the whale shark foraging BIA but vessels do not frequently transit through the BIA as they are likely to mobilise from Dampier to reach

	the operational area. Other plans that identify vessel strike as a potential threat include the below, though these species are not expected within the operational area. - Approved Conservation Advice for Balaenoptera borealis (sei whale) (TSSC, 2015b) - Approved Conservation Advice for Balaenoptera physalus (fin whale) (TSSC, 2015c) - Conservation Management Plan for the Southern Right Whale 2011 – 2021 (DSEWPaC, 2012h) Jadestone has had regard to the representative values of the protected areas within the RISK EMBAs, and the respective management plans and other published information. Interactions with fauna may have a minor impact on any of the social and ecological objectives and values, of AMPs, or state MPs. However, with controls in place to minimise the likelihood (to protect protected fauna), this is considered consistent with the objectives of the conservation advice or management plans and considered Acceptable.
ALARP	The residual risk has been demonstrated to be ALARP.

7.3 Unplanned release of solids

7.3.1 Description of Hazard

Aspect	Unplanned releases of solids (including dropped objects) may occur as a result of overfull and/or uncovered bins, incorrectly disposed items or spills during transfer of materials between the MODU and support vessels. For noting, objects dropped to seabed due to drilling operations are less likely as the MODU will be cantilevered over the Stag CPF and therefore any objects dropped during the drilling activities will likely land within the CPF footprint (i.e. topsides). A release of solids to the environment has the potential to occur from the following activities: ● Waste from MODU/ vessel operations; ● Dropped object during supply transfer; ● Accidental discharge of dry bulk products during supply transfer; or ● Accidental venting of bulk solids tanks (mud, cement products), approximately 40 m^3.

7.3.2 Impacts and Risks

Non-hazardous solid wastes such as plastics have the potential to pollute marine environments and harm fauna through entanglement or ingestion. Marine turtles and seabirds are particularly at risk from entanglement. Marine turtles may mistake plastics for food; once ingested, plastics can damage internal tissues and inhibit physiological processes, which can result in fatality. Generally, no toxic effects are expected from non-hazardous solids.

Release of hazardous solid wastes may result in the pollution of the immediate receiving environment, leading to detrimental health impacts to marine flora and fauna. Physiological damage can result through ingestion or absorption and may occur to individual fish, cetaceans, marine reptiles or seabirds. Marine fauna (including seabirds) encountered within the Operational Area are expected to be limited to small numbers of transient individuals, noting however that the area does overlap with the humpback whale and blue whale migration corridor, shearwater foraging, and the flatback turtle interesting areas which may result in a higher number of these species around the locations of drilling activities.

Damage or loss to marine habitats may occur from dropped objects supply activities undertaken between the MODU and support vessels, although these are not expected to be of a scale to cause significant damage or loss.

Benthic habitats have the potential to be impacted with accidental spills of solid wastes, including drilling bulk solids, resulting in possible damage to or loss of soft sediment communities within the area affected. The potential impact may be short term to long term depending on the waste type, its degradation rate, and the amount lost to the marine environment (approximately 40 m^3). In addition, the unplanned release of a buoyant, solid waste being accidentally released to the marine environment, it may create a navigational hazard.

The benthic habitats and associated biota that would be impacted in the accidental event of a non-buoyant dropped object are well represented in the region and there are no known areas of benthic primary producer habitat (e.g. corals, seagrass), KEF habitat (nearest KEF ~70 km N) or protected area habitat within the Operational Area. This is confirmed by Kinhill (1997, 1998) and potential losses represent a very small fraction of the widespread available habitat.

Supply vessels generate small quantities of similar wastes; these are managed in accordance with the vessels' own waste management plans and procedures.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***

Minor	Unlikely	Low

7.3.3 Environmental Performance

Hazard		**Non-hazardous and hazardous solid wastes (EUH-02)**		
Performance objective		**No release of non-hazardous or hazardous solid wastes to the marine environment**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
46	Waste generated during activity will be managed in accordance with MARPOL 73/78 Annex V Regulation 9 and the vessel/MODU's Waste Management Plan as required	Solid waste materials are stored in fit for purpose storage containers and/or lifting skips, labelled and equipped with lids / covers to prevent loss of material during storage and handling.	Garbage Record Book shall be maintained on all facilities in accordance with MARPOL 73/78 Annex V Regulation 9	MODU OIM
47		Hazardous solid wastes will be managed in accordance with Marine Orders – Part 94 (Marine Pollution Prevention – Packaged Harmful Substances), Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Part III) requirements, and Environmental Protection Regs (Controlled Waste)	A waste register will be maintained to show that hazardous wastes are being collected and returned onshore for disposal	Vessel Master MODU OIM
48	MODU Marine Operating Manual	Silos are pressure vessels controlled with PSV to prevent over pressuring and rupture of tank/ uncontrolled release of dry bulk solids	PSV register	MODU OIM
49	MODU/Vessel lifting procedures	All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility	Training records and Competency matrix	Vessel Master MODU OIM

7.3.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage the risk of unplanned solid discharges during the drilling activities. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
No use of hazardous materials or production of wastes	Eliminate	No	No	Solid wastes produced onboard are disposed of onshore and are not discharged to the marine environment, therefore there is no planned impact to the marine environment. Complete elimination of waste is not feasible; therefore, the risk of unplanned releases remains.
No lifting operations conducted	Eliminate	No	N/a	Lifting operations are an unavoidable activity to ensure the drilling activities are supplied with necessary goods and equipment, and to remove wastes and so cannot be eliminated
Substitute any hazardous chemical use with non-hazardous chemical use	Substitute	No	No	Where appropriate selection of chemicals or materials to achieve low or no environmental effect is made. Some hazardous waste is unavoidable from the use of batteries, lights etc. and therefore there are limited opportunities for substitution.
N/a	Engineering	N/a	N/a	All waste bins have lids and wastes are segregated at the time of disposal. No other engineering controls were considered.
Increase lifting capacity of cranes to decrease number of lifts required	Engineering	No	No	It is considered that to increase the lifting capacity of the cranes, they would need to be larger which would result in an increase in deck space usage. Whilst larger cranes could result in less lifts being required, it also increases risks to personnel from increased loads, increases risks to the seabed in the event that they are dropped and these are considered grossly disproportionate the risk of dropping objects.
N/a	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline. Lifting areas are over top deck and landing platforms isolating subsea infrastructure including pipelines from dropped load events; no further isolation controls were identified
N/a	Administrative	N/a	N/a	Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment. No further controls were identified. Lifting procedures and plans and Permit to Work requirements ensure all lifts are managed and reduce the risk of dropped objects.

7.3.5 Acceptability Assessment

The potential impacts of unplanned non-hazardous and hazardous solid waste accidental releases to the marine environment are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone’s HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone’s HSE Management System is capable of continuously reviewing and updating activities and their practices during drilling in permit WA-15-L to reflect the requirements of the Waste Avoidance and Resource Recovery Act and Controlled Waste Regulations.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to waste management practices during drilling.
Laws and standards	Requirements of the Waste Avoidance and Resource Recovery Act and Controlled Waste Regulations have been adopted.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to offshore activities.
Environmental context	Benthic habitats have the potential to be impacted with solids resulting in potential loss of soft sediment communities and harm to marine fauna. Disturbance is localised to immediately under or near to the footprint of existing Stag Facility subsea infrastructure present within the Operational Area. The potential impact may be short term to long term depending on the waste type and its degradation rate. If impacted, benthic habitats and associated biota are well represented in the region the potential scale of environmental harm from accidentally discharged solid waste is small in comparison to the vast size of soft substrata habitats spanning the NWS. The operational area is overlapped by four species BIAs. However, the areas that may be affected by accidentally discharged solid waste would represent a very small percentage of the total area. The Operational Area is within a habitat critical to survival for flatback turtles (inter-nesting buffer BIA). However, the potential scale of habitat loss and seabed disturbance from dropped objects is a very small percentage of the total area known. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management /Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD
Conservation and management advice	Marine debris is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice: • Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015-2025; • Conservation advice *Balaenoptera borealis* (sei whale); • Conservation advice *Balaenoptera physalus* (fin whale); • Recovery Plan for Marine Turtles in Australia; and • Recovery Plan for the white shark (*Carcharodon carcharias*). • *Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia’s coasts and oceans* (DoEE, 2018). • Approved Conservation Advice for the Abbott's booby Papasula abbotti (TSSC, 2020a) [specifically plastics]

	• Approved Conservation Advice on Rostratula australis (Australian painted snipe) (DSEWPaC, 2013b) [specifically plastics] These plans identify marine debris as potential threats to marine turtles, whales and other vertebrate wildlife resulting in potential injury or death and recommend adherence to legislation for the prevention of garbage disposal to prevent impacts. With debris that could float and result in entanglement or injection by marine life, the area of impact may extend beyond the operational area to within the identified EMBA, therefore a number of bird species with marine debris identified as a threat in conservation management plans may be vulnerable to impact. Controls implemented demonstrate that the activity will be conducted in a manner that reduces marine debris and therefore the activity will be conducted in a manner that is acceptable under the relevant Recovery Plans and Approved Conservation Advice to prevent accidental release of non-hydrocarbon solids (marine debris). The limited quantities associated with this event indicate that even in a worst-case release of solid waste, fatalities would be limited to individuals and is not expected to result in a decrease of the local population size for any of the species identified.
ALARP	The residual risk has been demonstrated to be ALARP.

7.4 Unplanned release of Non-hydrocarbon Liquids

7.4.1 Description of Hazard

Aspect	Non-hydrocarbon liquids, in particular chemical formulations, may be accidentally released to the marine environment. The largest instantaneous volume of a non-hydrocarbon hazardous liquid that could be released is one mud pit, a total volume of approximately 500 bbl or 80 m^3.

There may be accidental releases/ discharges to the marine environment of a variety of potentially non-hydrocarbon liquids used for drilling operations, which are stored and used or produced on the MODU and vessels during drilling operations. Materials that may be accidentally released include:

- Cementing chemicals;
- Spacers – used in front of cement for wettability of casing, cleaning;
- Mud; and
- Water-based liquids.

Operational chemicals, for example solvents and detergents, are typically stored in small containers of 5–25 L capacity and used in areas that are bunded. Generally speaking, it is not expected that these chemicals if spilt would enter the marine environment; rather they would be diverted into the drainage system.

Non-hydrocarbon liquids may also enter the marine environment during transfer operations (offloading or backloading) – for example, a dropped object event. In this scenario, the largest possible volume that may enter the marine environment is estimated at 1,000 L, the volume contained within an IBC which is assumed to be damaged during the lifting/ drop event such that the full volume is instantaneously released.

Further to these scenarios is what is considered to be the worst case credible release scenario of the accidental discharge of an entire mud pit containing WBM, due to poor handling and/ or storage practices. The maximum volume that could be released in one event is approximately 500 bbl or 80 m^3.

Impacts and risks associated with the accidental release of hydrocarbons to the marine environment are discussed in Sections 7.5 and 7.6.

7.4.2 Impacts and Risks

The impacts associated with the accidental discharge of non-hydrocarbon liquids is related to the nature of the material released, the volume and its behaviour in the marine environment (sink/ float/ disperse etc.). For the purposes of this impact assessment, evaluation of the worst case credible release scenario, that of 120 m^3 of WBM accidentally discharged to the marine environment, has been evaluated.

If WBM is discharged to the sea in this accidental scenario, it is expected that the plume will largely disperse at sea surface due to the fine particles present in the liquid (for noting, the discharge of WBM from the mud pit does not contain cuttings, and therefore the discharge behaviour in the marine environment is slightly different to the case of planned drilling discharge scenarios considered in Section 6.5). The released mud within the upper water column will disperse with the prevailing currents away from the release point and be diluted rapidly in the receiving waters. In well-mixed sea waters, drilling fluids can be expected to be diluted by 100-fold within 10 m of the discharge and by 1,000-fold after a transport time of about 10 minutes at a distance of about 100 m from the release point (Neff, 2005).

Most drilling mud ingredients are non-toxic or used in such small amounts in WBM that they do not contribute to its toxicity.

If hazardous liquids are accidentally lost overboard, potential impacts will include a temporary and highly localised decline in water quality. The potential for toxicity to marine fauna is limited due to the temporary exposure and low toxicity resulting from the rapid dilution in the marine environment.

It is noted that the Operational Area overlaps with the humpback whale migration BIA and pygmy blue whale distribution BIA, wedgetail shearwater breeding BIA, and the flatback turtle internesting buffer BIA which may result in a higher number of these species in the area. Potential impacts to water quality are likely to be limited to the immediate vicinity (tens to hundred metres) of the release point, and are not expected to affect overall population viability of these protected species in the event of an unplanned release.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***
Minor	Unlikely	Low

7.4.3 Environmental Performance

Hazard		Unplanned discharge of non-hydrocarbon liquids		
Performance outcome		**Zero unplanned discharges into the marine environment**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
50	Vessels and MODU are compliant with Marine Order 94 to prevent any packaged harmful substances from entering the marine environment	Safety data sheet (SDS) available for all chemicals to aid in the process of hazard identification and chemical storage and disposal management	SDS available	HSE Manager Marine superintenden t Vessel master OIM
51		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations	SDS available	
52	Vessels and MODU are compliant with Marine Order 93 to prevent any contaminating liquids and chemicals from entering the marine environment	Chemical management is compliant with Marine Order 93: ● Having a valid International Pollution Prevention Certificate; ● Reporting marine incidents to AMSA – An incident involving a discharge from a vessel of a mixture containing a liquid substance, carried as cargo or as part of cargo in bulk, must be reported to AMSA via AMSA Form 196 (Harmful Substances Report form) within 24-hours; ● Enacting a compliant Shipboard Marine Pollution Emergency Plan; ● Using a compliant Cargo Record Book; and ● Washing vessel tanks in accordance with the Pollution Prevention Act.	Valid International Pollution Prevention Certificate Valid SOPEP/SMPEP Cargo Record Book	
53	Spill kits on the vessel are present in areas of high spill risk	Spill kits are: ● Located near high risk spill areas. ● Intact, clearly labelled and contain adequate quantities of absorbent materials with waste managed as per vessel Waste Management Plan	Pre-start inspection	

7.4.4 ALARP Assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of non-hydrocarbon liquids. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
N/a	Eliminate	N/a	N/a	Industry-standard technologies are not available to eliminate the use of chemicals, including drilling mud; therefore, elimination of non-hydrocarbon liquids cannot be eliminated and the risk of unplanned releases remains.
N/a	Substitute	N/a	N/a	Where appropriate selection of chemicals or materials to achieve low or no environmental effect is made. SBM has not been selected for use, therefore reducing the potential for environmental impact, and all drilling, completions and cement chemicals used downhole are Gold/ Silver/ D or E rated through OCNS, or have a complete risk assessment, as per Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) therefore reducing the potential for environmental impact.
N/a	Engineering	N/a	N/a	Safeguards will be implemented as required, by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and MARPOL Annexures I, II and III. Such safeguards may include (but are not limited to) inventory minimisation, designated storage and handling areas, correct stowage, accurate labelling and marking, SDS information, spill clean-up equipment and containment (e.g. bunds). No other potential controls were identified.
N/a	Isolation	N/a	N/a	
N/a	Administrative	N/a	N/a	Procedures are in place for the handling and management of liquids. No additional administrative controls were identified.

7.4.5 Acceptability Assessment

The potential impacts of unplanned non-hydrocarbon liquids are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to the risk of non-hydrocarbon liquids discharges.
Laws and standards	Relevant legal and regulatory controls have been adopted.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social licence to operate.
Environmental	While the risk of unplanned non-hydrocarbon liquid discharges could occur during the

context	activities, and have an impact on the waters immediately nearby, the impact and risk assessment process indicates that accidental discharges will have a temporary and localised impact on marine waters and will not result in significant impact to marine fauna including those species' BIAs that overlap the area. The potential impact is considered acceptable after consideration of: - Potential impact pathways - Preservation of critical habitats - Assessment of key threats as described in species and Area Management/ Recovery plans - Consideration of North-West Bioregional Plan; and - Principles of ecologically sustainable development ESD.
Conservation and management advice	Minimising chemical discharge is an action identified by the Recovery Plan for Marine Turtles in Australia 2017-2027. This requires that best practice industrial management is implemented to minimise impacts to marine turtle health and habitats. A marine chemical spill is unlikely to result in population effects due to the controls in place for secure storage and on-board clean-up of spills, transient nature of marine fauna and the remote open ocean environment. There are no relevant management requirements in the recovery plan to implement for this hazard.
ALARP	The residual risk has been demonstrated to be ALARP.

7.5 Unplanned Release of Stag Crude Oil

7.5.1 Description of hazard

Aspect	This section considers a surface release of Stag crude oil from impact with the subsea export pipeline resulting in a release of up to 120m^3 crude.

A HAZID was undertaken for the Stag drilling activities and the Worst-Case Spill (WCS) is considered to be the unplanned discharge of Stag crude oil due to the persistent nature of Stag crude. Although the marine diesel spill scenario is larger in volume (refer Section 7.6), marine diesel is highly volatile, easily entrains, non-persistent and evaporates quickly on the surface water. The scenario is summarised in Table 7-2.

Table 7-2: Credible Stag crude oil spill to the marine environment

Scenario	Maximum Credible Spill	Release duration	Credibility justification
Loss of integrity from the conductor due to MODU collision	**68 m^3** of crude oil Surface release	5 hours	The maximum volume of the 4 x conductors = 68 m^3.
Damage to pipeline due to dropped object resulting in pinhole leak	**15m^3** of crude oil Subsea release	12 hours	Assumes damage to pipeline (approximately 5mm hole) and no Lo LO triggered. Release rate of ~1.2m^3/hr.
Damage to pipeline or riser due to dropped object	**86.5m^3** of crude oil Subsea release	30 minutes	This scenario assumed a flow rate of 173m^3/hr over a 30 minute period through a hole size of 15mm. This scenario covered a loss from the underbuoy hose (a finite volume), but the location of this is outside the operational area for this activity. The scenario is included as a representative spill modelling scenario for damage to the riser or pipeline with a high flow rate.
Damage to pipeline due to dropped object	**120m^3** of crude oil Subsea release	12 hours	Assumes a hole size of 20mm due to impact from a dropped object Release rate of 10m^3/hr through the hole, pipeline inventory is 70m^3, therefore assumes full inventory loss plus time to shut in pipeline.

The HAZID identified Stag crude release scenarios that would not occur, or, where due to the small volumes or inherent barriers in design did not result in the Stag crude being released into the marine environment. These included:

<u>Release of Stag crude oil due to well blow out</u>

As described in the Stag Well Operations Management Plan (WOMP) (GF-50-PLN-W-00001), through review of the Stag reservoir in November 2011 (Dowling and Betts, pers. comm., 2011) it was determined that the pressure in the reservoir is not sufficient to flow oil to the surface in the event of a loss of all well barriers. As the reservoir has been produced, the pressure has declined with time such that fluids (oil and produced water) will not flow to the surface unless an Electric Submersible Pump (ESP) is running in the well. In the event of a severe loss of well integrity and corresponding shutdown of the Stag artificial lift system, the reservoir pressure will be unable to support a column of well fluids to surface where seawater will effectively kill the well.

Some wells (Stag 12H and Stag 36H) have recently experienced positive surface pressures when shut in, which would indicate the wells have the capability of free flowing limited quantities gas to surface. This is due to the wells experiencing a period of higher gas rates than previously observed. Despite the higher surface pressures, the bottom hole pressures (as measured in the wells) still preclude the ability of the wells to free flow oil and produced water to surface. To further mitigate against the potential for these wells to freeflow, downhole tubing retrievable surface controlled subsurface safety valves (TRSCSSSV) has been installed in these wells.

As such a well blow-out during drilling activities is not deemed a credible scenario and not considered further.

Release of marine diesel/ Stag crude oil due to vessel grounding

A release of hydrocarbon due to vessel grounding and subsequent fuel tank rupture resulting from a loss of propulsion or due to navigational error resulting in a vessel running aground in shallow areas was not considered a credible scenario for the activity as it is situated in deep water (approximately 50 m) and there are no charted reefs or islands that pose a grounding hazard. This is confirmed by seabed surveys in the operational area and surrounds.

7.5.2 Stag Crude Oil Characteristics

Stag oil is a medium crude composed of hydrocarbons that have a wide range of boiling points and volatiles at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Change in the mass balance calculated for Stag crude weathering under low (5 knots) and constant wind indicates that approximately 14% of the oil volume would evaporate within 12 hours. The remaining oil would weather at increasingly slower rate as the mixture becomes proportionally enriched by compounds with longer carbons chains, hence higher boiling points. Once all volatile compounds have evaporated, only the residual compounds will remain, and weathering rates would slow significantly. After one day approximately 40 to 80% is predicted to remain on the sea surface (% dependent upon wind variability). This reduces to approximately 32 to 68% of the crude remaining on the surface after seven days.

A summary of the physical properties of Stag crude oil is provided in Table 7-3.

Table 7-3: Characteristics of Stag crude oil

Hydro-carbon	Initial density (g/cm^3) @ 15°C	Viscosity (cP) @ 20°C	Component	Volatiles (%)	Semi-volatiles (%)	Low volatility (%)	Residual (%)	Aromatics (%) Of whole oil
			BP (°C)	**<180**	**180–265**	**265–380**	**>380**	**<380**
Stag crude oil	0.944	115	% of total	0.5	16.0	40.8	42.8	11.3
			% aromatics	0.2	3.0	8.1	-	-
			-	**Non-persistent**			**Persistent**	

Source: APASA (2020)

Further detail on Stag crude oil is provided in the OPEP and Appendix C.

Toxicity Testing of Crude Oil

Toxicity testing using the water accommodated fraction (WAF) of Stag oil indicated that the oil would be of low acute toxicity to organisms in the water column (Battelle, 1998). In 96-hour exposure tests, no acute toxicity was observed on two species of tropical fish (a clownfish: *Amphiprion clarkii*, and a silverside: *Menidia beryllina*) in an undiluted solution of the WAF (Table 7-4). Similarly, there was no acute toxicity observed on a tropical prawn (*Penaus vannamei*) after 96 hours' immersion in the undiluted WAF, while a tropical mysid shrimp (*Mysidopsis bahia*) suffered mortality after 96 hours' exposure in a high-concentrations of the WAF (30% survival in undiluted WAF).

In tests on the potentially more sensitive planktonic larvae of invertebrates (using the larvae of three species of sea urchin: *Arbacia punctulata*, *Dendraster excentricus*, and *Strongylocentrotus purpuratus*), there was no reduction in the rate of normal larval development, or of survival after 60 hours' exposure to undiluted WAF.

In a final test involving relatively long term exposure of stony corals (a five-day exposure test using *Acropora elysii*) corals survived in an undiluted solution of WAF made from fresh oil; however, growth was inhibited by two thirds. In contrast, five days' immersion in an undiluted WAF solution made from oil weathered for 0.5–1 days had no effect upon the growth of the corals.

Table 7-4: Toxicity testing results of water accommodated fraction (WAF) of Stag crude

Test Species	Test Codes	Exposure Level – Stag Crude	
		% of WAF	mg/L TPH*
Clownfish *(A. clarkii)*	LC_{50}96hLC_{50}	>100	>273
Silverside *(M. beryllina)*	LC_{50}96hLC_{50}	>100	>273
Mysid Shrimp *(M. bahia)*	LC_{50}96hLC_{50}	72	87
Penaid Prawn *(P. vannamei)*	LC_{50}96hLC_{50}	>100	>219
Sea Urchin Larvae	EC_{50}96hEC_{50}	>100	>219
Stony Coral *(A. elysii)*	EC_{50}120hEC_{50}	>50	>110

* Test Codes: 96hLC50 Concentration causing mortality to 50% of the test organisms after 96 hours (4 days) exposure; 96hEC50 concentration causing an effect on the rate of normal larval development during 60 hours (2.5 days) exposure; 120hEC Concentration causing a significant reduction in the growth rate during 120 hours (5 days) exposure

Given the low asphaltene content of the weathered residue, Stag crude will have low adherence properties when coming into contact with environmental receptors. The degree to which impacts could occur will depend upon the level of coating (concentration of oil and/or loading of oil on shorelines) and how fresh the oil is, with toxicity from oil contact likely to be more prevalent from 'fresh' oil closer to the Stag Facility.

The viscosity of Stag crude would increase through weathering and the uptake of water to form an oil-in-water emulsion. The maximum water uptake for Stag crude has been measured at 74–81% for fresh and weathered crude, respectively, resulting in a stable emulsion (Battelle, 1998). Consequently, the volume of the slick increases over time through the uptake of water to form a viscous emulsion

7.5.3 Modelling Approach

To determine the spatial extent of impacts from a potential hydrocarbon spill and the dispersion characteristics of the oil over time, modelling was completed by Asia-Pacific Applied Sciences Association (RPS APASA, 2020). Oil spill modelling was undertaken using a three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces.

Near-field subsea discharge modelling was undertaken using OILMAP, which predicts the droplet sizes that are generated by the turbulence of subsea discharges as well as the centreline velocity, buoyancy, width and trapping depth (if any) of the rising gas and oil plumes.

Spill modelling was performed using a number of simulated environmental conditions from all seasons thus providing a range of realistic spill trajectories from which to determine the spatial extent of potential impacts and receptors which might be affected by a spill.

A summary of the modelling method is described below.

1. **Stochastic approach**: stochastic modelling was carried out using an historic sample of wind and current data for the 'study area' that spanned ten years. For each season (March to August and September to February), a large number of replicate simulations (100) were modelled (i.e. 200 in total), each initialised at different, randomly selected points in time for that seasonal period and hence under a different time series of environmental conditions. This stochastic sampling approach provides an objective measure of the possible outcomes of a spill, because environmental conditions will be selected at a rate that is proportional to the frequency that these conditions occur over the study area. More simulations will tend to use the most commonly occurring conditions, while conditions that are more unusual will be represented less frequently.
2. **Contact thresholds**: Oil spill models are able to track hydrocarbon concentrations of surface oil, entrained oil and DAH below biologically significant impact levels. Consequently, threshold concentrations are specified for the model to control what contact is recorded for surface oil and subsurface locations (entrained oil and DAH) to ensure that recorded contacts are for biologically meaningful concentrations. Thus, it is important to describe the thresholds used as the boundary of the EMBA will be influenced by the thresholds set in the hydrocarbon spill modelling.

The determination of biologically meaningful impact thresholds is complex since the degree of impact will depend on the sensitivity of the biota contacted, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The toxicity of a hydrocarbon changes over time, due to weathering processes altering the composition of the hydrocarbon. To ensure conservatism in defining the EMBA boundary and the subsequent impact assessment, the threshold concentrations applied to the model are based on the most sensitive receptors that may be exposed, the longest likely exposure times and the more toxic hydrocarbons.

Impact pathways and impact threshold concentrations are detailed in Appendix D for floating oil, entrained oil and DAH.

3. **Data generated:** during each simulation (of which there are 100 for each season), the model recorded the location (latitude x longitude x depth) of each of the particles (representing a given mass of hydrocarbon) on or in the water column, at regular time steps.

The collective records from all simulations were then analysed by dividing the study area into a three-dimensional grid. For oil particles classified as being at the water surface, the sum of the mass in all hydrocarbon particles located within a grid cell, divided by the area of the cell provided an estimate of the concentration of oil in that grid cell, at each time step.

For entrained and dissolved hydrocarbon particles, concentrations were calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell. The concentrations of oil calculated for each grid cell, at each time step, were then analysed to determine whether concentration estimates exceeded defined threshold concentrations. The risks were then summarised as follows:

- The probability of exposure at a location was calculated by dividing the number of spill simulations where contact occurred above a contact threshold at that location by the total number of replicate spill simulations. For example, if contact occurred at the location (above a contact threshold) 50 out of 100 simulations, a probability of exposure of 50 per cent is indicated; and
- The minimum potential time to a shoreline location was calculated by the shortest time over which oil was calculated to travel from the source to the location in any of the replicate simulations.

4. **Probability contours**: the results were presented in terms of statistical probability maps based on 100 simulations, each generated under different environmental conditions. The contours of probability are

not representations of a single spill event (APASA 2020).

5. **Completion of modelling**: each of the 100 simulations was run for a period of two to three weeks allowing for the fate of dispersed hydrocarbons to be evaluated. Fate assessment stops once hydrocarbon concentrations fall below the defined contact thresholds. In this manner, the full extent of the spill scenario is assessed against the specified contact thresholds.

For the purposes of assessing sensitive receptors contacted, the sensitive receptor areas were delineated into segments for modelling purposes (refer Figure 7-1).

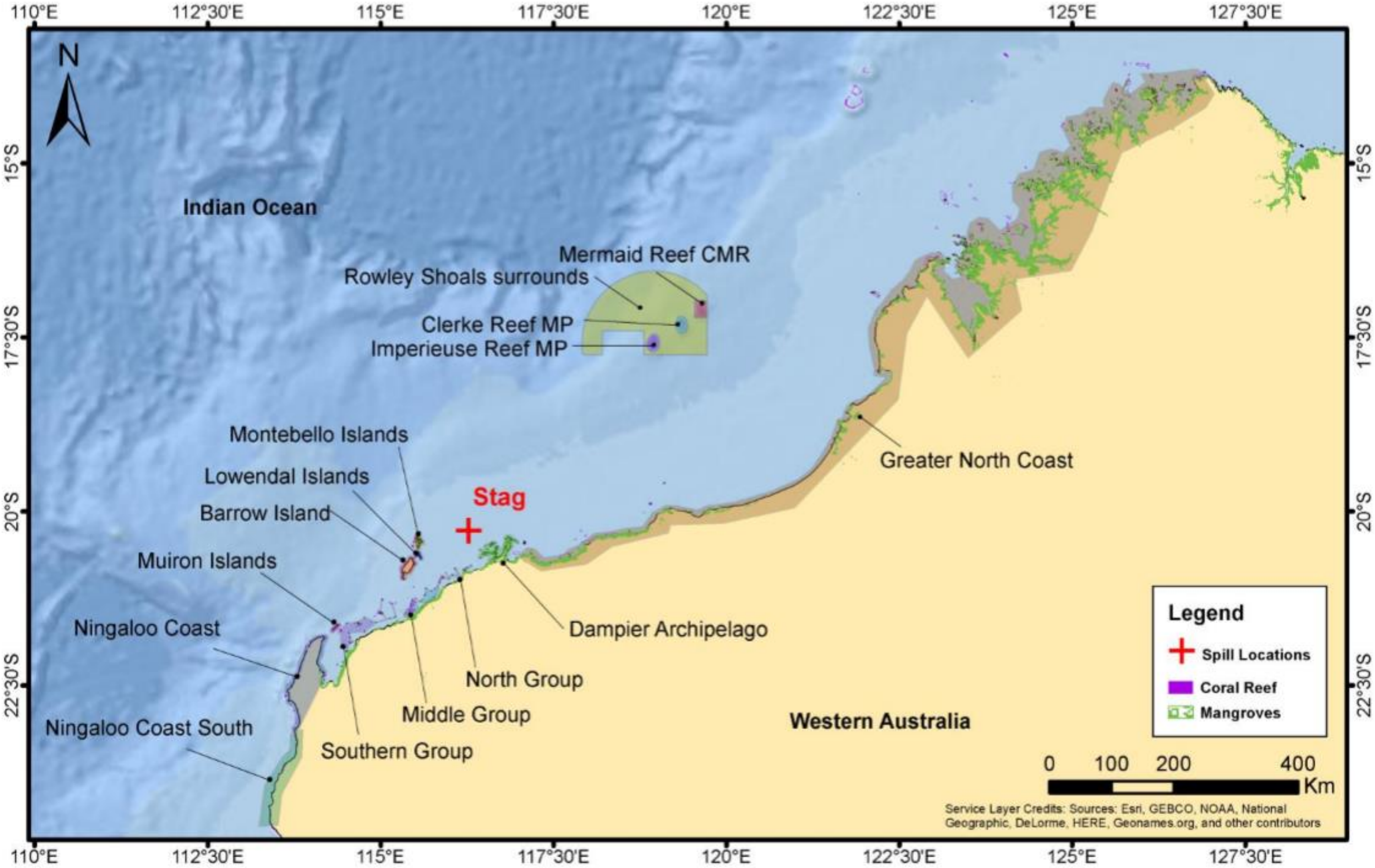

Figure 7-1: Sensitive receptor segments for modelling purposes

7.5.3.2 Contact thresholds

To assess environmental effects from an unplanned hydrocarbon release, four separate hydrocarbon components that pose differing environmental risks were evaluated:

- Surface hydrocarbons – hydrocarbons that are 'on' the water surface;
- Entrained hydrocarbons – hydrocarbon that is entrained 'in' the water;
- Dissolved hydrocarbons – the dissolved component of hydrocarbon in' the water; and
- Shoreline accumulation – hydrocarbons that accumulate along shorelines.

Threshold concentrations for each of the three hydrocarbon phases were developed and applied to the modelling outputs to define the EMBA for each phase. A receptor was considered 'affected' by one of the phases as soon as the threshold for the phase at that location was exceeded (i.e. instantaneous impact approach).

The rationale for the selection of the thresholds is described in Appendix D and a summary of the contact thresholds applied is provided in Table 7-5. The EMBA (Figure 3-1) is denoted by the lowest hydrocarbon exposure thresholds to indicate all receptors that may be *contacted* by hydrocarbons of any phase from any scenario. However, for the purposes of impact assessment, higher exposure thresholds are applied, termed as 'moderate' in NOPSEMA bulletin #1, (Table 7-5) to indicate the receptors that could be *affected* (rather than just contacted) and is based on scientific knowledge to determine the potential for impact. A RISK EMBA is then drawn utilising these thresholds which lies within the overall EMBA using the moderate threshold values in Table 7-5.

Table 7-5: Summary of the contact thresholds applied in the hydrocarbon spill modelling

Floating oil (g/m^2)		Shoreline Oil		Entrained oil (ppb)		DAHs (ppb)	
1	Low (approximates range of socio-economic effects and establishes planning area for scientific monitoring)	100	Moderate (loading predicts area likely to require clean-up effort)	100	High (as appropriate given oil characteristics for informing risk evaluation)	70	Medium (approximates potential toxic effects)
10	Moderate (approximates lower limit for harmful exposures to birds and marine mammals)						

7.5.3.3 Modelling Results

Modelling of two subsea stag crude spills was undertaken in 2020:

A $120m^3$ Stag crude spill from the subsea pipeline representing the release in the event of a loss of pipeline integrity. This scenario assumed a flow rate of $10m^3/hr$ over 12 hours through a hole diameter of 20mm.

An $86.5m^3$ spill due to damage from a flexible underbuoy hose, riser or subsea pipeline in the Stag field. This scenario assumed a worst case flow rate of $173m^3/hr$ over a 30 minute period through a hole size of 15mm.

The modelling of these scenarios are considered appropriate to use for this activity as:

- The location is within the Stag field and therefore subjected to the same weathering and climatic conditions
- Stag crude is the same hydrocarbon modelled
- The release is subsea, but a spill from a MODU conductor could occur at surface or just below the surface
- The volume released is slightly larger than that expected for this activity.

When comparing the two EMBAs that resulted from both modelling reports, the EMBA was larger from the 86.5m^3 spill across all phases of hydrocarbon and resulted in higher volumes of shoreline contact at more locations than the 120m^3 spill. The difference in EMBA spread is likely due to the difference in flow rate and hole size between the two scenarios. The two EMBAs are shown in Figure 7-2, and therefore to ensure conservatism for this EP, the EMBA selected is the 86.5m^3 loss of stag crude scenario to represent any of the stag crude loss of hydrocarbon scenarios.

The RISK EMBA is derived from the seasonal stochastic modelling results (i.e. results from all 200 replicates), hence describes a substantially larger area than would be affected during any single spill event. The RISK EMBA is based on Jadestone's specifications of moderate thresholds for floating oil (1 g/m^2 and 10 g/m^2), shoreline oil (100 g/m^2), entrained oil (100 ppb) and DAH (70 ppb) concentrations.

Floating Oil Results

Results of the worst-case modelling (September to February) indicate that surface sheens of floating oil (>1 g/m^2 and 10 g/m^2) may pass over the following sensitive receptors, with a probability of >1% of reaching these locations, noting that floating oil will not accumulate on submerged features or at open ocean locations (Table 7-6).

Floating oil concentrations at or greater than 1 g/m^2 could travel up to 703 km from the release location (March to August), with the distances reducing to 36 km (September to February) as the contact threshold increases to 10 g/m^2 (RPS APASA, 2020).

Table 7-6: Modelling results for floating oil due to 86.5 m^3 Stag crude release

Receptor Type	Receptor	>1 g/m^2	>10 g/m^2
Australian Marine Parks	Gascoyne MP	Y	N
	Argo-Rowley Terrace MP	Y	N
	Dampier MP	Y	N
	Eighty Mile Beach MP	y	N
	Montebello MP	Y	N
Biologically Important Areas	Marine Turtle BIA	Y	Y
	Seabirds BIA	Y	Y
	Fish and Sharks BIA	Y	Y
	Whales BIA	Y	Y
Islands	Montebello Islands	Y	N
	Barrow Island	Y	N
	Lowendal Islands	Y	N
Key Ecological Features	Ancient Coastline at 125m Depth Contour	Y	N
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF	Y	N
	Continental Slope Demersal Fish Communities	Y	N
	Exmouth Plateau	Y	N
	Glomar Shoals	Y	N
State Marine and National Parks	Barrow Island MMA	Y	N
	Barrow Islands MP	Y	N
	Montebello Islands MP	Y	N

Entrained Oil Results

Entrained oil is most likely to drift to the east for spills commencing during summer and transition months, with drift to the west, followed by the southwest also likely for a spill commencing in the transitional seasons. For a spill commencing in winter months, entrained oil is most likely to drift to the southwest, following the offshore bathymetry of the region. Shoreline contact could occur from entrained oil at the Montebello Islands.

Highest maximum nearshore concentrations of entrained oil are predicted to occur along shorelines of the Montebello Islands at 169 ppb for spills commencing during winter months. And 181 ppb in summer months.

For 100 ppb the minimum arrival time is 11 hours to the Montebello Marine Park (in winter months). The maximum entrained hydrocarbon concentration at any depth in the worst replicate is 1,288 ppb at the Montebello Islands MP. Receptors potentially contacted by entrained oil are listed in Table 7-7.

Table 7-7: Modelling results for entrained oil >100ppb due to 86.5 m^3 Stag crude release

Receptor Type	Receptor
Australian Marine Parks	Montebello Marine Park
Biologically Important Areas	Marine Turtle BIA
	Seabirds BIA
	Sharks BIA
	Whales BIA
Islands	Montebello Islands
Key Ecological Features	None
State Marine and National Parks	Montebello Islands MP

Dissolved Aromatic Hydrocarbons

DAH concentrations at or greater than 70 ppb are not predicted within the modelling domain for this scenario.

No receptors are predicted to receive DAH concentrations equal to or greater than 70 ppb during either season.

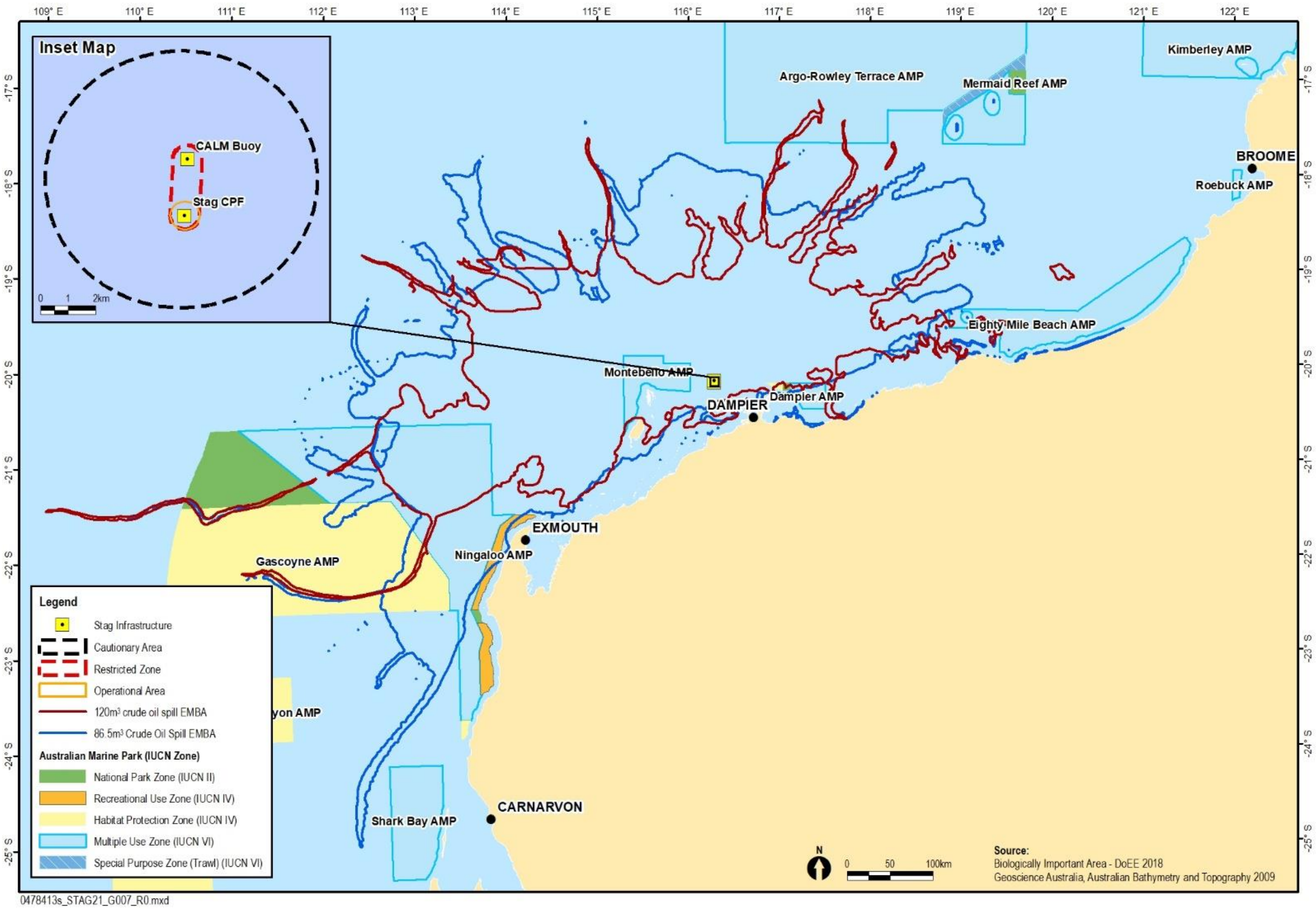

Figure 7-2: EMBAs - Modelled spill trajectories for all seasons for all hydrocarbon phases at low exposure thresholds resulting from release of Stag crude [86.5 m^3] at the Stag Facility within Annualised EMBA of low exposure thresholds

7.5.4 Impacts and Risks

The maximum worst-case credible scenario was used to determine the nature and scale of impacts to sensitive receptors. The following sources of information were used:

- Overlaying the modelled impact from a release of 86.5 m^3 (refer section 7.5.3.2) oil on known benthic habitats and shorelines in the region;
- Review of hydrocarbon impact thresholds (environmental and socio-economic);
- A search of the EPBC Act protected matters database; and
- Predictions of Stag crude oil shoreline contact from APASA (2020).

Hydrocarbon spills can cause chemical (e.g. toxic) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface and ingestion) impacts to marine species. The level of impact depends on the magnitude of the hydrocarbon spill (i.e. severity, extent, duration etc.) and sensitivity of the receptor contacted. Table 7-8 identifies the physical and chemical pathways and oil impacts to habitats, marine organisms and socio-economic receptors at locations in the EMBA.

The properties of Stag crude oil relevant to impact considerations are its persistent fraction, low likelihood of entrainment, low toxicity due to its highly weathered state, and it low adherence due to the low asphaltene content of the weathered residue.

In general, the oil floats when released on the sea surface, because it is less dense than seawater. Hence, small volumes of a surface spill would tend to get deposited on the seabed, especially when dealing with a relatively small surface release like the one assessed for Stag drilling activities. The modelling results show no prediction of oil deposited on the sediments.

7.5.4.2 Floating Oil

Floating oil impacts may include coating of marine flora, fauna and habitats or ingestion by marine fauna.

Shoreline habitats

Shoreline habitats which have the potential to be contacted by stranded oil include intertidal coral reefs, cays, sandy shorelines, mangroves, rocky shorelines and intertidal mud/sandflats. Fauna associated with these can be exposed to toxic effects from ingestion as fauna attempt to clean themselves (e.g. preening of feathers or licking fur), reduced mobility and inability to thermoregulate due to oil coating, contact to eyes, noses and breathing apparatus (invertebrates) from oil coating can result in irritation and/or inability to breathe or see.

Corals

Contact of floating Stag crude oil could occur with intertidal corals at low tide. The degree to which impacts such as bleaching, mortality or reduced growth could occur will depend upon the level of coating (concentration of oil and/or loading of oil on shorelines) and how fresh the oil is.

Prolonged contact of oil with corals has been observed to lead to tissue death and bleaching to exposed parts of colonies. Dosages of DAH are not predicted to reach levels where hydrocarbons dissolved under floating oil could impact intertidal or subtidal corals. Since Stag crude oil has a persistent fraction, extended contact with hard intertidal corals could occur and recovery of intertidal coral communities could be on scale of multiple years to decades, dependent upon the level of contact. A number of important coral areas could be contacted, dependent upon weather conditions and resultant spill trajectory, including Montebello/ Barrow/ Lowendal Islands, Dampier Archipelago and the Rowley Shoals (marine parks). Coral at these locations have been identified as a KPI in the respective marine park management plans (Table 3-14).

Table 7-8: Physical and chemical pathways and oil impacts to habitats, marine organisms and socio-economic receptors

Receptor	Location in EMBA	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Rocky Shore	Barrow Island, Montebello Island, Ningaloo Coast including North-West Cape, Dampier Archipelago	Shoreline loading and attachment.	Degree of oil coating is dependent upon the energy of the shoreline area and the type of the rock formation Solid consolidated rock is likely to receive a lower degree of persistent oiling than lower energy shorelines	External contact by oil and adsorption across cellular membranes Impacts to flora and fauna as per this table	Impacts to sessile flora and fauna as per this table
Sandy Shore	Eighty Mile Beach, Muiron Islands, Imperieuse Reef, Barrow Island, Montebello Islands, Lowendal Islands, Clerke Reef MP, Dampier Archipelago, Thevenard Island, Bedout Island, Turtle Island	Shoreline loading and water movement may act to drive oil into sediments	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct impacts to in-fauna	Toxicity of sediment and reduced oxygen availability within the sediments as a result of oil smothering and microbial biodegradation	Indirect impacts to nesting and foraging habitats for birds and turtles including EPBC listed species and KPIs within marine parks as per Table 3-14. Direct impacts (mortality) to in-fauna through toxic effects and smothering
Intertidal flats	Eighty Mile Beach (KPI), Barrow Island, Montebello Islands, Dampier Archipelago,	Shoreline loading and attachment to fine substrates	Indirect impacts to foraging habitats for birds & turtles. Direct impacts to infauna	Muddy substrates are likely to promote sedimentation of oil and binding of sediments by oil	Indirect impacts to foraging habitats for birds. Direct impacts (mortality) to in-fauna through toxic effects and smothering including EPBC listed species and KPIs within marine parks as per Table 3-14

Receptor	Location in EMBA	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Mangroves	Eighty Mile Beach (KPI), Barrow Island (KPI), Montebello Islands, Lowendal Islands, Dampier Archipelago	Smothering of root system reducing air and salt exchange	Yellowing of leaves, defoliation, disease, increased predation, tree death, reduced growth, reduced reproductive output, reduced seed viability	External contact by oil and adsorption across cellular membranes Uptake of DAH across cellular membranes	Yellowing of leaves, defoliation, disease, increased predation, tree death, reduced growth, reduced reproductive output, reduced seed viability, growth abnormalities
Algae and seagrass	Muiron Islands, Imperieuse Reef, Barrow Island (KPI), Montebello Islands (KPI), Lowendal Islands, Clerke Reef MP, Dampier Archipelago, Barrow-Montebello Surrounds, Rowley Shoal Surrounds, Glomar Shoals, Montebello AMP, Dampier AMP, Mermaid Reef AMP	Smothering of leaves/thalli reducing light availability and gas exchange	Bleaching or blackening of leaves, defoliation, reduced growth	External contact by oil and adsorption across cellular membranes Uptake of DAH across cellular membranes	Mortality, bleaching or blackening of leaves, defoliation, disease, reduced growth, reduced reproductive output, reduced seed/ propagule viability
Hard corals	Muiron Islands (KPI), Montebello Islands (KPI), Lowendal Islands, Dampier Archipelago, Barrow-Montebello Surrounds, Thevenard, Airlie and Serrurier Islands, Rowley Shoal MP (Clerke and Imperieuse Reef), KPI Glomar Shoals, Montebello AMP, Eighty Mile Beach AMP, Mermaid Reef AMP	Smothering of polyps reducing light availability	Bleaching, increased mucous production, reduced growth	External contact by oil and adsorption across cellular membranes Uptake of DAH across cellular membranes	Mortality, cell damage, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced egg/ larval success, growth abnormalities

Receptor	Location in EMBA	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Invertebrates	All locations including: Eighty Mile Beach, Barrow Island, Dampier Archipelago, Rowley Shoal MP (KPI), Clerke and Imperieuse Reef), Gascoyne AMP, Ningaloo AMP, Montebello AMP, Dampier AMP, Eighty Mile Beach AMP, Mermaid Reef AMP, Argo-Rowley Terrace AMP, Kimberley AMP	Smothering of adults, eggs and larvae - Reduced mobility and capacity for oxygen exchange	Mortality, oxygen debt, starvation, dehydration, increased predation, behavioural disruption	Ingestion and internal adsorption External contact and adsorption across exposed skin and cellular membranes Uptake of DAH across cellular membranes Indirect impact to predators through ingestion of oiled prey	Mortality, cell damage, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced egg/ larval success, growth abnormalities, behavioural disruption
Fish and Sharks (including EPBC species listed in Table 3-3)	All locations including BIA's for: Dwarf Sawfish, Freshwater Sawfish, Green Sawfish; and Whale Sharks (refer Figure 3-6) Additional locations include: Eighty Mile Beach, Muiron Islands, Barrow Island, Montebello Islands, Dampier Archipelago, Barrow-Montebello Surrounds, Rowley Shoal Surrounds (Clerke and Imperieuse Reef), Glomar Shoals, Gascoyne AMP, Ningaloo AMP, Montebello AMP, Dampier AMP, Eighty Mile Beach AMP, Mermaid Reef AMP	Smothering of adults but primarily eggs and larvae - Reduced mobility and capacity for oxygen exchange	Mortality, oxygen debt, starvation, dehydration, increased predation, behavioural disruption	Ingestion and internal adsorption External contact and adsorption across exposed skin and cellular membranes Uptake of DAH across cellular membranes (e.g. gills) Indirect impact to predators through ingestion of oiled prey	Mortality, cell damage, flesh taint, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced egg/ larval success, growth abnormalities, behavioural disruption

Receptor	Location in EMBA	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Birds (including EPBC species listed in Table 3-3	BIA's for the following bird species: Wedgetail shearwater, Roseate tern, Lesser crested tern, Lesser Frigatebird, Fairy Tern, Brown booby, Little tern, White-tailed tropicbird (refer Table 3-7) Additional locations include: Argo-Rowley Terrace AMP, Eighty Mile Beach (including Ramsar site), Muiron Islands, Barrow Island, Montebello Islands, Lowendal Islands, Thevenard Island, Bedout Island, Clerke Reef (Bedwell Island), Dampier Archipelago Barrow-Montebello Surrounds Montebello AMP, Rowley Shoal Surrounds, Mermaid Reef AMP, Eighty Mile Beach AMP, Gascoyne AMP, Argo-Rowley Terrace AMP	Smothering - Feather matting and damage, reducing insulation, mobility and buoyancy Secondary smothering of eggs and hatchlings	Mortality, drowning, starvation, dehydration, increased predation, hypothermia, behavioural disruption	Ingestion (during feeding or preening) and internal adsorption External contact and adsorption across exposed skin and membranes Secondary contact and adsorption by eggs and hatchlings Indirect impact to predators through ingestion of oiled prey	Mortality, cell damage, lesions, secondary infections, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced hatchling success, growth abnormalities, behavioural disruption
Marine reptiles	BIA's for the following turtle species: Flatback, the hawksbill, green, loggerhead and leatherback turtle Additional locations include: Eighty Mile Beach, Muiron Islands, Imperieuse Reef, Barrow Island, Montebello Islands, Lowendal Islands, Clerke Reef MP, Dampier Archipelago, Barrow-Montebello Surrounds, Rowley Shoal Surrounds, Glomar Shoals, Montebello AMP, Eighty Mile Beach AMP, Gascoyne AMP, Mermaid Reef AMP, Argo-Rowley Terrace AMP	Smothering (particularly hatchlings) – reduced mobility and buoyancy	Mortality, drowning, starvation, dehydration, increased predation, behavioural disruption	Inhalation of volatile compounds Ingestion and internal adsorption External contact and adsorption across exposed skin and membranes Indirect impact to predators through ingestion of oiled prey	Mortality, cell damage, lesions, secondary infections, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced hatchling success, growth abnormalities, behavioural disruption

Receptor	Location in EMBA	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Marine mammals	BIA's for the following mammal species: the dugong, humpback whale, blue whale Other locations include: Muiron Islands, Imperieuse Reef, Broome to Roebuck, Montebello Islands, Lowendal Islands, Clerke Reef MP, Dampier Archipelago, Barrow-Montebello Surrounds, Montebello AMP, Eighty Mile Beach AMP, Rowley Shoal Surrounds, Dampier AMP, Mermaid Reef AMP, Kimberley AMP	Smothering – fur damage and matting, reduced mobility and buoyancy (for applicable species) Smothering of feeding apparatus in some species (i.e. baleen whales)	Mortality, drowning, starvation, dehydration, increased predation, hypothermia, behavioural disruption	Inhalation of volatile compounds Ingestion and internal adsorption External contact and adsorption across exposed skin and membranes Indirect impact to predators through ingestion of oiled prey	Mortality, cell damage, lesions, secondary infections. Reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced hatchling success, growth abnormalities, behavioural disruption
Socio- economic and heritage	Eighty Mile Beach, Muiron Islands, Imperieuse Reef, Barrow Island, Montebello Islands, Lowendal Islands, Dampier Archipelago, Barrow-Montebello Surrounds, Rowley Shoal and Surrounds, Glomar Shoals, Montebello AMP, Eighty Mile Beach AMP, Mermaid Reef AMP,	Smothering of socio-economic/tourism amenities such as sandy shores. Floating oil on sea surface may prevent vessels (commercial/ recreational) from utilising area Economic effect on industry due to restricted zones, impacts to values, impacts to fishery/aquaculture (e.g. pearls, seaweed) stocks	Loss of income, restriction of access, reduction in aesthetic values leading to negative effect on tourism (both short and long term), loss of aquaculture, human health risk	Entrained oil and DAH may be ingested by fish stocks Reduction in water quality can result in impacts to aquaculture	Decrease in fishery stock levels, reduced marketability of product, tainted flesh in fish, perceived reduction in health of habitat, pearl/ seaweed industry tainted stock, loss of income

Corals at the Montebello/ Barrow/ Lowendal islands and Dampier Archipelago have the potential to be impacted by the greatest volumes and more toxic (less weathered crude oil) although it should be noted that Stag crude oil has a relatively low toxicity due to its highly-weathered state.

Impacts to hard corals could be intensified if a spill was to reach shallow coral areas during the peak spawning season of March/ April since floating oil could smother intertidal corals in the process of spawning or could contact floating coral eggs and larvae following spawning events. Dependent on the level of contact, this could diminish coral recruitment, and impact longer term recovery.

Presence of surface oil can affect light qualities and the ability of macrophytes to photosynthesise. Reduced primary productivity could occur while surface oil is present.

Mangroves and salt marshes

Mangrove root systems (including pneumatophores) are sensitive to physical coating by crude oil which may persist for long periods of time given the persistent components of Stag crude oil and the tendency for mangrove root habitat to trap oil. This could have prolonged negative effects on the faunal communities within mangroves. Of the emergent habitat types mangroves are likely to be one the most susceptible and slowest recovering habitat types with recovery potentially on a decadal scale if death of trees was to occur. Mangroves could be impacted at the Montebello, Lowendal, Barrow Islands, Dampier Archipelago and shoreline areas along Eighty Mile Beach. These mangroves are identified as KPI values within many of the respective management plans (Table 3-14).

Floating crude oil could reach salt marsh areas (Eighty Mile Beach), which are often landward of mangrove communities, on high spring tides. Salt marshes would likely trap floating crude oil to a certain degree and therefore persistent oil may remain within these areas even after tidal water has receded. This could have prolonged negative effects on the faunal communities within salt marshes. Depending upon the degree of weathering, Stag crude oil may have toxic impacts from physical coating of salt marshes potentially ranging from death to sub lethal stresses such as reduced growth rates and reduced reproductive output/ success. Such impacts would be restricted to the seaward fringes of salt marsh communities.

Fish and sharks

Near the sea surface, fish can detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Kennish, 1997; Scholz et al., 1992). As a result, wide-ranging pelagic fish species of the open ocean generally are not highly susceptible to impacts from hydrocarbon spills. This includes the EPBC listed whale shark (whose foraging and high density foraging BIA overlaps the EMBA (Figure 3-6), great white and grey nurse shark, oil pollution is identified as a threat in their respective conservation advice (SPRAT whale shark, great white shark and grey nurse shark, DEE 2017as). BIAs for sawfish are also within the EMBA and conservation advice identifies marine pollution as a risk for green sawfish.

Assessment of the effects on Timor Sea fish following the Montara incident indicated that fish collected initially in Phase I and II of monitoring showed evidence of exposure to petroleum hydrocarbons at sites close to the West Atlas drilling rig, with samples collected one year after (Phase III) suggesting an ongoing trend toward a return to normal biochemistry/ physiology (Gagnon and Rawson, 2011).

Most reef fish are expected to be buffered from contact to floating surface slicks by the overlying water column. For example, shallow water reef habitats extend to 15–20m depth along island coastlines allowing reef fish species to seek refuge from floating oil slicks. Reef fish in the shallowest areas are more susceptible to hydrocarbon spill impacts however, as many reef fish are site attached residents on the reef and are unlikely to move away if their territory is impacted. Impacts due to contact with floating oil may include reduced mobility and capacity for oxygen exchange, behavioural disruption or mortality.

Marine mammals

Whales, dolphins and dugongs are smooth skinned, hairless mammals so hydrocarbons tend not to stick to their skin therefore physical impacts from surface oil coating is unlikely. Pinnipeds are more susceptible to physical coating as hydrocarbons tend to adhere to rough surfaces, hair or calluses of animals. Irritation to eyes, ears, airways and/or skin may occur from contact with surface slicks.

Physical impacts due to ingestion are applicable to surface slicks; however, the susceptibility of cetacean and pinnipeds species varies with feeding habits. Baleen whales are more likely to ingest surface slick hydrocarbon than "gulp feeders" such as toothed whales and are particularly vulnerable to hydrocarbon ingestion while feeding. Oil may stick to the baleen while the whales "filter feed" near slicks. Humpback whales, whose migration BIA overlaps the EMBA are more likely to occur in the area during the northern migration period in June/July and southern migration in Sep/Oct so a sea surface plume (>10 g/m^2) of oil might contact humpback whales as they migrate. Similarly, blue whales may encounter a sea surface plume (>10 g/m^2) as they pass through the area during their northern migration in May–August as a distribution and migration BIA also overlaps the EMBA.

Marine mammals are at risk of inhaling volatile compounds evaporating from a spill if they surface to breathe in an oil slick (Geraci and St Aubin, 1990).

Marine reptiles

Marine turtles and sea snakes when surfacing to breathe may be affected from surface slick hydrocarbons through damage to their airways and eyes. Turtles and sea snakes may be affected by oil through tainted food source or by absorption through the skin. Risk of contact would likely be greatest along intertidal sections of nesting beaches or within shallow waters adjacent to nesting beaches. Contact might also occur within foraging areas, for example along the Ningaloo and Muiron Islands shorelines and Dampier AMP.

The flatback, green, hawksbill and loggerhead turtle BIAs (including foraging, internesting, nesting and mating) overlap the EMBA (Table 3-4), and the Stag facility overlaps a suggested 60 km inter-nesting buffer from the nesting beaches on Dampier Archipelago for the flatback turtle (Error! Reference source not found.). H owever, while oil may be impacted as described above, oil spills are not identified as a key threat to these species in the conservation advice (SPRAT) or in the recovery plan (EA 2003).

Seabirds

Seabirds are highly susceptible to hydrocarbon spills and oiled birds may experience hypothermia due to matted feathers and an inability to fly. These impacts are primarily attributed to oiling of birds at the surface from slicks. Oiled birds may experience decreased foraging success due to a decline in prey populations following a spill (Andres 1997, NRC 2003) or due to increased time preening to remove oil from their feathers (Burger 1997). During both winter and migration, shorebirds spend much of their time feeding and depend on nonbreeding habitats to provide the fuel necessary for migratory flight (Withers, 2002).

Oil can reduce invertebrate abundance or alter the intertidal invertebrate community that provides food for nonbreeding shorebirds (Andres 1997, NRC 2003) such as at the Eighty Mile Beach Ramsar site. Reduced abundance of a preferred food may cause shorebirds to move and forage in other—potentially lower-quality—habitats. Prey switching has not been documented in shorebirds following an oil spill. However, shorebirds will feed in alternative habitats when the intertidal zone alone cannot fulfil their energy requirements.

A bird’s inability to obtain adequate resources delays its pre-migratory fattening and can delay the departure for its breeding grounds. Birds arriving on their breeding grounds earlier realise higher reproductive success through increased clutch size and offspring survival (for a review, see Harrison et al. 2011). If coastal habitats are sufficiently degraded by oil that pre-migratory fattening is slowed and birds delay departure for their breeding grounds, the individual effects could carry over into the breeding season and into distant breeding habitats (Henkel et al. 2012).

The breeding BIA of several EPBC listed bird species overlap the EMBA (Table 3-7) and may be affected by oil. The wedge tailed shearwater breeding BIA overlaps the Stag facility operational area and oil pollution is identified as a low threat to the species (SPRAT Wedge-tailed shearwater, DEE 2017a).

Socio-economic

Surface oil may impact upon socio-economic receptors including the oil and gas industry, commercial shipping, fisheries/aquaculture, recreation and tourism, resulting in an economic and social impact. Floating and stranded oil can be highly visible and have a resultant negative effect on tourism. A sheen of oil ($1g/m^2$) may be visible slightly further than the EMBA for biological impacts boundary and impact on the values of a marine park or tourism beach – in particular Ningaloo coast and Exmouth.

Many of the protected areas have ‘wilderness’ and ‘seascapes’ identified as a value, and these would be compromised by the presence of any oil.

Impacts on the values associated with Protected Areas may result in loss of fauna/ habitat diversity and/ or abundance, reduction in commercial/recreational/ subsistence fishing, loss of livelihood and loss of income from reduced tourism and commercial productivity.

There are no thresholds identified at which smothering or volume ashore will result in an impact, however those shorelines with the highest load, and those identified as significant threatened or migratory fauna habitat are the most susceptible to impact. Table 7-8 lists key potential impacts to sensitive receptors present in the EMBA.

Several of the AMPs, have conservation values associated with biological attributes including migratory seabirds, flatback turtles, humpback whales, freshwater, green and dwarf sawfish, Australian Snubfin, Indo-Pacific Humpback and Indo-Pacific bottlenose dolphins. A concentration of 1 mg/m^2 would not be expected to have any impact on these values but may affect tourism visitation.

7.5.4.3 Entrained Oil

Total oil in the water column has the potential to coat benthic and susceptible shoreline habitats and organisms.

Shoreline habitats

Intertidal and subtidal zones may be exposed to entrained hydrocarbons with impacts similar to coral reefs. Impacts may occur due to increased hydrocarbon levels in the nearshore waters and in sediments above the low water mark. Concentrations of hydrocarbons in nearshore waters and sediments, will fluctuate over short time scales (days to weeks), due to volatilisation, wave and tidal action, biological processes and potential arrival of more oil. Fauna associated with these habitats may experience sub-lethal effects. However, due to the expected weathering of Stag crude, the accessibility of polycyclic aromatic hydrocarbons (PAHs) to aquatic organisms is decreased.

Similar to benthic habitats, recovery of shoreline habitats exposed to entrained hydrocarbons and experiencing impacts would be expected within weeks to months of return to normal water quality conditions.

Benthic

The smothering of submerged benthic habitats and those within tidal zones from water column oil has only been reported where very large oil spill quantities have affected these habitats or very sticky oil slicks have encountered exposed coral surfaces or polyps. Where entrained oil reaches the shoreline habitats of intertidal zones, sub-lethal effects may occur, with mangroves and reef areas being the most sensitive.

Benthic habitats in the EMBA that may be impacted by entrained oil include soft sediments and benthic fauna, coral reef, macroalgae and seagrasses. Recovery of benthic habitats exposed to entrained hydrocarbons and experiencing impacts would be expected within weeks to months of return to normal water quality conditions. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Burns et al., 1993; Dean et al., 1998).

Coral

There is a paucity of information on the long-term impacts on coral reefs of hydrocarbons entrained in the water column although NOAA (2001) indicate that some effects may be transient whilst others are long-lasting depending on the type of corals, reproduction period and health of the reef. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva et al., 2008).

Entrained hydrocarbon concentrations below parts per million (ppm) concentrations in marine waters have not been associated with any observed stress, degradation or death of corals. Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. Presence of entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes to photosynthesise. Reduced primary productivity could occur while entrained hydrocarbons are present in the water column.

Waters that contain extensive fringing coral reef may experience impacts from entrained hydrocarbons as described below for benthic habitats. Reefs are often characterised by increased levels of biological productivity, which attracts commercially valuable fish species. Impacts from entrained hydrocarbons will be as described below for reef fish.

Mangroves

Mangrove communities may be impacted through the sediment/ mangrove root interface. Where entrained hydrocarbons include contaminants that may become persistent in the sediments (e.g. trace metals, PAHs), this can lead to effects on mangroves due to uptake, or effects on benthic infauna leading to reduced rates of bioturbation and subsequent oxygen stress on the plants' root systems (Lewis et al., 2011).

Fish and sharks

Reef fish with high site fidelity will experience protracted water quality conditions with entrained hydrocarbon concentrations >500 ppb within the EMBA. Hydrocarbon droplets can physically affect reef fish exposed for an extended duration (weeks to months) by coating of gills. This can lead to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces resulting in increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth (NRC, 2005). Lethal effects to reef fish may be observable within days to weeks. Sub-lethal effects of coral reef fish communities will take weeks to months to become measurable.

Pelagic and demersal fish species (including sharks) exposed to entrained hydrocarbons can result in tainting and contamination of fish flesh by insoluble PAHs associated with the weathered hydrocarbon (refer Section 7.5.4.4 for further information on tainting).

Whale sharks feed on plankton, krill and bait fish near or on the water surface and it is possible that they may come into contact with entrained oil, or ingest entrained oil if a large-scale spill occurred when they (and their prey) were present in the region (Woodside, 2005).

Whale sharks are known to transit the NW coast and aggregate from late March to June in the vicinity of the Ningaloo coast, (generally peaks in April). If a spill event overlapped with this time, whale sharks may experience entrained hydrocarbon concentrations >100 ppb. While whale sharks may be exposed to entrained hydrocarbons, they could be migrating to aggregation areas beyond the impact zone, in which case exposure would be short term and confined to the EMBA and spill duration/ dispersion periods.

Marine mammals

Impacts to marine mammals from entrained hydrocarbons could result in behavioural (e.g. deviating from migratory routes or commonly frequented feeding grounds) impacts. These impacts may affect individuals within or transiting the spill area during migration.

Whales, dolphins and dugongs are smooth skinned, hairless mammals so hydrocarbons tend not to stick to their skin therefore physical impacts from entrained oil coating is unlikely. Pinnipeds are more susceptible as hydrocarbons tend to adhere to rough surfaces, hair or calluses of animals. Irritation to eyes, ears, airways and/or skin may occur from contact with entrained oil.

Impacts from ingested hydrocarbon can be lethal or sub-lethal. However, the susceptibility of marine mammal species varies with feeding habits as with surface oil (described previously). Entrained oil attached to seagrass can also be ingested by dugongs.

Oil may foul sensory hairs around the mouth and/or contact eyes while surfacing to breathe which may cause inflammation and infections. Similar to cetaceans, inhalation of volatile compounds evaporating from a spill may also result in physiological impacts to dugongs.

Marine reptiles

Turtles and sea snakes may be affected by oil through tainted food source or by absorption through the skin. Turtle hatchlings and turtle/sea snake adults may be exposed to hydrocarbon through ingestion of entrained hydrocarbons and tainted food source. These effects may cause physiological effects such as disruption of digestion. As for other megafauna that may be exposed to entrained hydrocarbons, acute impacts due to exposure to adult turtles are not expected.

Seabirds

Seabirds may come into contact with entrained oil while searching for food (diving) below the sea surface, exposure times would be very short in this scenario limiting the opportunity for oiling of feathers. Short-term physiological effects due to ingestion of entrained oil or contaminated prey may also occur. Ingested oil can have several sublethal toxicological effects, including haemolytic anaemia, reduced reproduction, and immunosuppression.

Socio-economic

Impacts to fish may result in tainted flesh and fishery closure resulting in an economic impact on commercial and subsistence fishing. Entrained oil can also lead to impacts on aquaculture (e.g. pearls, seaweed) due to a decrease in water quality and reduced stock. Reduced marketability of products (perceived or real) could occur for target species. Tourism may be impacted by real or perceived reduction in health or mortality of habitats that support tourism activities.

Table 7-8 lists key potential impacts to sensitive receptors present in the EMBA.

7.5.4.4 Dissolved Aromatic Hydrocarbons

The moderate threshold for DAH is not reached for the crude spill scenarios; however, the detail is provided here as it is reached for the marine diesel spill scenario (Section 7.6).

While there is some debate in the scientific literature (Barron et al., 1999), the main component of oil generally thought to be responsible for the majority of toxicity to wildlife is the DAH compounds that dissolve into the water column following a spill. Various studies indicate that the toxic effects of aromatic compounds result from the narcosis caused in biological receptors following exposure to low molecular weight aromatics including compounds from the BTEX group and 2−4 ring PAHs (French, 2000).

Accumulation of petroleum hydrocarbons by marine organisms is dependent on the bioavailability of the hydrocarbons, the length of exposure, and the organism’s capacity for metabolic transformations of specific compounds. Actual toxicity depends on both concentration and the duration of exposure, being a balance between acute and chronic effects.

Acute toxicity

Toxicity to wildlife increases with increased length of exposure; marine organisms can typically tolerate high concentrations of toxic hydrocarbons over short durations (French 2000; Pace et al., 1995).

DAHs have a narcotic effect on organisms, resulting from interference with cell function that occurs as hydrocarbons are absorbed across cell membranes (French-McCay, 2002). The narcotic effect varies among specific hydrocarbon compounds, with these variations thought to be attributable to the lipid solubility of the compounds. Over periods of hours to a few days, the narcotic effect has been found to be additive, both in severity and the number of different soluble hydrocarbons that are present (French, 2000; NRC, 2005; Di Toro et al., 2007).

Because the toxicity of DAH to aquatic organisms increases with time of exposure, organisms may be unaffected by brief exposures to a given concentration but affected at long exposures to the same concentration (French-McCay, 2002). This is due to the fact that the concentrations of hydrocarbons build up in the tissues of biological receptors from either long-term exposure or repeated exposure to sub-lethal concentrations.

Chronic toxicity and accumulation

There is sparse data available on the chronic effects of PAHs in the marine environment. A review of the processes controlling the uptake and persistence of PAH in marine organisms, especially under chronic exposure conditions, highlighted differential mechanisms of uptake, tissue distribution, and elimination (Meador et al., 1995). While vertebrates have a high capacity for metabolising aromatic hydrocarbons including PAHs (through cytochrome P450 1A mediated oxidation), PAHs can accumulate in the body of invertebrates (as they lack a cytochrome P450 1A mediated oxidation system). Organisms that may experience chronic effects include plankton, fish, marine mammals and marine reptiles. Table 7-8 lists key potential impacts to sensitive receptors present in the EMBA.

Pelagic fish are highly mobile and comprise species such as sharks and migratory whale sharks. The likelihood of pelagic fish being continuously exposed to DAHs for >96 hours is unlikely therefore acute/ lethal effects are not predicted (Luyeye, 2005). However, chronic/ non-lethal effects may be experienced. As a chronic action of PAHs is a neurotoxic effect, chronic exposure of pelagic fish may cause delayed predatory/ avoidance response times, disorientation, swimming action/ efficiency.

Whale sharks migrate along the NW coast from late March to September. If a spill event overlapped with this time period, whale sharks may experience exposure above the DAH threshold as they migrate through the area.

Tainting by DAHs of commercially targeted pelagic fish species may occur. Tainting can have a range of effects from affecting edible quality of the fish and have economic consequences, to containing toxic levels above recommended human consumption guidelines. While tainted pelagic fish will recover naturally over time (months) once water quality conditions have returned to normal, re-opening of a fishery will require an understanding of when recovery from tainting has occurred for the target species of interest.

Marine mammals that may occur within the EMBA for DAHs include dugongs, whales and dolphins in offshore waters. According to Geraci and St Aubin (1990), inhalation of volatile compounds evaporating from a spill at sea surface is the greater risk to cetaceans when surfacing to breathe. For these marine mammals, the potential for chemical effects due to exposure is considered unlikely, particularly for highly mobile species such as dolphins because it is very unlikely that these animals will be constantly exposed to high concentrations for continuous durations (e.g. >96 hours) that would lead to toxic effects.

The majority of publicly available information detailing potential impacts to turtles and sea snakes due to exposure to hydrocarbons is based on impacts due to heavy oils. Impacts due to exposure to DAHs are less understood. One information source provides a case study detailing a spill of 440,000 gallons of aviation gasoline nearby to an island supporting approximately 1,000 green turtles that aggregate and nest at the atoll in the west Pacific Ocean annually (Yender and Mearns, n.d.). Timing of the spill was of concern as it coincided with expected peak hatchling emergence. Population comparisons with a census that had been completed just prior to the spill were undertaken to evaluate impacts; no impacts were reported during the spill response and population effects were not detected.

For marine reptiles that may be exposed to DAHs dosages that exceed the threshold, acute impacts to turtles and sea snakes are not expected. Impacts to turtle hatchlings may occur however due to the risk of them becoming entrained in a parcel of water allowing them to be continuously exposed to toxic hydrocarbons for an extended period.

Socio-economic receptors will be affected by hydrocarbon exposure in three key ways: loss of Income (e.g. reduction in catch for commercial fisheries), restriction of access and reduction in aesthetic values. Impacts to fish may result in tainted flesh and fishery closure resulting in an economic impact on commercial fishing. DAH in the water column can also lead to impacts on aquaculture (e.g. pearls, seaweed) due to a decrease in water quality and reduced stock. Reduced marketability of products (perceived or real) could occur for target species. Tourism may be impacted by real or perceived reduction in health or mortality of habitats that support tourism activities.

7.5.4.5 Receptors

Key ecological features (KEFs)

The crude spill modelling does not indicate contact with any KEFs at moderate thresholds.

Commonwealth and State Marine Reserves

The following state and Australian Marine Parks are located within modelled spill trajectories of a crude oil release at moderate thresholds:

- Montebello Australian Marine Park; and
- Montebello Island Marine Park.

These parks were established to protect both habitats and species groups as described in Section 3. Many of the values are listed as KPI and are considered unique to the protected area and include habitats, fauna or ecological features. Impacts to the values may compromise the management objectives of the managed areas, which may have flow-on effects to tourism revenue of coastal communities that provide access to these marine reserves. The reserves listed above may also support nursery/ feeding/ aggregation areas for fisheries species and therefore may assist in maintaining healthy fish stocks for both commercial and recreational fisheries.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***
Major	Unlikely	Medium

7.5.5 Protection Priorities

The Protection Priorities are the most likely to be contacted locations across ALL modelled scenarios, they are used for spill response planning purposes for the initial response capability. In a real event, the IAP, NEBA and planning process takes over; utilising real time operational data and focusing operations on locations to be contacted (which will be a subset of what is planned for). This allows for preparedness and planning for the most credible scenarios whilst retaining flexibility in response to manage an event.

The following Protection Priorities (refer Section 5.7.5) for spill response have been determined from the modelling results for both crude and marine diesel spills:

- Eighty Mile Beach;
- Montebello Islands;
- Dampier Archipelago;
- Barrow Island; and
- Lowendal Islands.

Table 7-9 summarises the rationale for the Protection Priorities selection (also refer to Section 5.7.5) and Appendix F details the specific key values and modelled contact of the Protection Priorities. Note that the worst-case value is presented for the receptor as a whole e.g. Montebello Islands includes the marine park, MMA and surrounds, the minimum time to contact/maximum concentration on any one of those receptors is taken. The only exception is that shoreline oil is only reported for receptors with shorelines (i.e. MP boundaries are not reported for shoreline contact). Note that marine diesel results are also presented to inform the assessment of protection priorities.

An assessment was conducted to determine the Environmental Performance Outcome (EPO) for the locations and the spill response measures that would be required to meet the EPO and thereby reduce impacts associated with spill response to ALARP (Table 7-10). These assessments form the basis of determining the required level of spill response resourcing, as detailed in the OPEP and the justification that spill risk has been reduced to ALARP.

7.5.6 Net Environmental Benefit (NEBA)

Net Environmental Benefit Analysis (NEBA) is a structured approach used by the spill response community and stakeholders to select spill response strategies that will effectively remove oil, are feasible to use safely in particular conditions, and will reduce the impact of an oil spill on the environment.

The NEBA process is used during pre-spill planning (Strategic NEBA) and during a response (Operational NEBA). A Strategic NEBA is an integral part of the contingency planning process and is used to ensure that response strategies for scenarios are well informed. An Operational NEBA is used to ensure that evolving conditions are understood, so that the response strategy can be adjusted as necessary to manage individual response actions and end points.

Balancing trade-offs may involve differing and conflicting priorities, values and perceptions of the importance of sensitive receptors. There is no universally accepted way to assign perceived value or importance and is not a quantitative process. Overall, the NEBA process provides an estimate of potential environmental effects which are sufficient to allow the parties to compare and select preferred combinations of response strategies to reduce environmental impacts to ALARP.

Table 7-11 provides a summary of spill response strategies available for each of the Protection Priorities identified and the potential impact that a response strategy has on the environmental values of the area, noting that response strategies are not used in isolation. This information is to be considered in the NEBA process during the development of the Incident Action Plan in a spill response (i.e. an Operational NEBA). An Operational NEBA will also consider feedback from operational and scientific monitoring activities (refer OPEP), real time monitoring of the effectiveness and potential impacts of a response and will also consider accessibility, feasibility and safety of responders.

Table 7-9: Rationale for Determination of Protection Priorities for Spill Response from worst case spill scenarios

[thresholds – >10g/m^2 floating oil, >100ppb entrained oil, >70ppb dissolved oil]

Location in RISK EMBA	Stag Crude spill (Subsea 86.5m^3) all seasons	Marine diesel spill (surface 250m^3) all seasons	Protection Priority?	Rationale
Dampier Archipelago	<1% floating oil contact probability above the threshold <1% entrained oil contact probability, maximum concentration below threshold <1% dissolved oil contact probability, maximum concentration in worst replicate 7ppb Max accumulated volume along shoreline with concentrations exceeding 100 g/m^2: 19m^3 Minimum time to contact for floating oil >10g/m^2, 165 hours	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil contact probability above the threshold, maximum concentrations 40ppb Maximum local accumulated concentration in worst replicate 0.3g/m^2 No contact for floating oil >10g/m^2	Y	Some shoreline loading of crude - maximum volume ashore 19m^3, 165 h to floating oil contact (minimum), <1% probability of contact. Entrained and dissolved marine diesel contact above thresholds
Middle Pilbara Islands and Shoreline	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil contact probability above the threshold, maximum concentrations <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >10g/m^2, 561 hours	<1% floating oil contact probability above the threshold <1% entrained oil above threshold with a maximum concentration of 3ppb <1% dissolved oil contact probability above the threshold, maximum concentrations <1ppb Maximum local accumulated concentration in worst replicate 0.3g/m^2 No contact for floating oil >10g/m^2	N	Very low shoreline loading from crude and marine diesel spills
Greater North Coast / Eighty Mile Beach inc CMR and RAMSAR	<1% floating oil contact probability above the threshold, <1%, entrained and dissolved oil contact probability above the threshold and maximum concentrations <1ppb Max accumulated volume along shoreline with	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil above threshold with maximum concentration of 15 ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2	Y	Contains 80MB Ramsar site, KPI habitats (mangroves and saltmarsh) within 80MB Marine Park, maximum crude volume ashore 10m^3, limited marine diesel volumes

Location in RISK EMBA	Stag Crude spill (Subsea 86.5m^3) all seasons	Marine diesel spill (surface 250m^3) all seasons	Protection Priority?	Rationale
	concentrations exceeding 100 g/m^2: 7m^3 Minimum time to contact for floating oil >10g/m^2, 430 hours	No contact for floating oil >10g/m^2		
Montebello Islands inc. CMR	<1% floating oil contact probability above the threshold 2% entrained oil above threshold with a maximum concentration of 181ppb (at the marine park boundary) <1% dissolved oil above threshold with a maximum concentration of 34 ppb in the worst replicate (at the marine park boundary) Max accumulated volume along shoreline with concentrations exceeding 100 g/m^2: 33m^3 Minimum time to contact for floating oil >10g/m^2, 29 hours	<1% floating oil contact probability above the threshold 40% entrained oil above threshold with a maximum concentration of 5,973ppb (at the marine park boundary) 2% dissolved oil above threshold with a maximum concentration of 168 ppb in the worst replicate (at the marine park boundary) Maximum local accumulated concentration in worst replicate 6.6g/m^2 No contact for floating oil >10g/m^2	Y	Shoreline loading - significant turtle nesting beaches identified in recovery plan (2003), intertidal coral habitats (KPI) in marine park, EPBC bird nesting habitat, floating, entrained and dissolved oil contact from crude and marine diesel spills
Lowendal Island	<1% floating oil contact probability above the threshold <1% entrained oil contact probability and maximum concentration 28ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 15ppb in the worst replicate Max accumulated volume along shoreline with concentrations exceeding 100 g/m^2: 7m^3 Minimum time to contact for floating oil >10g/m^2, 50 hours	<1% floating oil contact probability above the threshold 2% entrained oil contact probability and maximum concentration 424ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 16ppb in the worst replicate Maximum local accumulated concentration in worst replicate 8.1g/m^2 No contact for floating oil >10g/m^2	Y	Low shoreline loading from crude spill, higher entrained marine diesel volumes

Location in RISK EMBA	Stag Crude spill (Subsea 86.5m³) all seasons	Marine diesel spill (surface 250m³) all seasons	Protection Priority?	Rationale
Barrow Island inc. surrounds (MMA and MP)	<1% floating oil contact probability above the threshold, <1% entrained oil contact probability and maximum concentration 2ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 3ppb in the worst replicate Max accumulated volume along shoreline with concentrations exceeding 100 g/m^2: $2m^3$ Minimum time to contact for floating oil >$10g/m^2$, 565 hours	<1% floating oil contact probability above the threshold 2% entrained oil contact probability and maximum concentration 544ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 30ppb in the worst replicate Maximum local accumulated concentration in worst replicate $2.5g/m^2$ No contact for floating oil >$10g/m^2$	Y	Shoreline loading significant turtle nesting beaches identified in recovery plan (2003), intertidal coral habitats (KPI) in marine park, bird nesting habitat, - maximum volume ashore $6m^3$, 52 hours to floating oil contact (minimum). 544ppb entrained marine diesel and some dissolved oil contact.
Exmouth Gulf (SE & W)	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil contact probability, Maximum concentration of entrained and dissolved oil <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2	No contact above any threshold	N	low probability floating oil contact above the threshold, very low shoreline loading from entrained only
Karratha to Port Hedland	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil contact probability maximum concentration of entrained and dissolved oil <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >$10g/m^2$, 289 hours	<1% floating oil contact probability above the threshold <1% entrained oil contact probability and maximum concentration 5ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 1ppb in the worst replicate No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 No contact for floating oil >$10g/m^2$	N	Low shoreline loading, limited sensitive receptors
Port	<1% floating oil contact probability above the	No contact above any threshold	N	Low shoreline loading 80MB

Location in RISK EMBA	Stag Crude spill (Subsea 86.5m^3) all seasons	Marine diesel spill (surface 250m^3) all seasons	Protection Priority?	Rationale
Hedland to Eighty Mile Beach	threshold <1% entrained and dissolved oil contact probability maximum concentration of entrained and dissolved oil <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >10g/m^2, 265 hours			already a PP
Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF	<1% floating oil contact probability above the threshold <1% entrained and dissolved oil contact probability maximum concentration of entrained and dissolved oil <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >10g/m^2, 644 hours	No contact above any threshold	N	Low contact volumes
Clerke Reef	<1% floating oil contact probability above the threshold, <1% entrained and dissolved oil contact probability maximum concentration of entrained and dissolved oil <1ppb No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >10g/m^2, 629 hours	No contact above any threshold	N	low probability floating oil contact above the threshold, very low shoreline loading from entrained oil only
Imperieuse Reef	<1% floating oil contact probability above the threshold, <1% entrained and dissolved oil contact probability maximum concentration of entrained and dissolved oil <1ppb	No contact above any threshold	N	Minimal shoreline loading

Location in RISK EMBA	Stag Crude spill (Subsea 86.5m^3) all seasons	Marine diesel spill (surface 250m^3) all seasons	Protection Priority?	Rationale
	No accumulated volume along shoreline with concentrations exceeding 100 g/m^2 Minimum time to contact for floating oil >10g/m^2, 565 hours			
Ningaloo Coast including World Heritage, State MP	No contact above any threshold	<1% floating oil contact probability above the threshold <1% entrained oil contact probability and maximum concentration 94ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 4ppb in the worst replicate Maximum local accumulated concentration in worst replicate 0.3g/m^2 No contact for floating oil >10g/m^2	N	Minimal shoreline loading
Muiron Islands MMA	No contact above any threshold	No floating oil contact probability above the threshold <1% entrained oil contact probability and maximum concentration 55ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 3ppb in the worst replicate No local accumulated concentration No contact for floating oil >10g/m^2	N	Minimal shoreline loading
Gascoyne AMP	No contact above any threshold	No floating oil contact probability above the threshold <1% entrained oil contact probability and maximum concentration 81ppb in the worst replicate <1% dissolved oil contact probability and maximum concentration 9ppb in the worst replicate No local accumulated concentration No contact for floating oil >10g/m^2	N	Minimal shoreline loading

Table 7-10: Impact of a spill response strategy on the environmental values of Protection Priorities

Protection Priority environmental values	No controls	Source control	Dispersant (surface)*	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Cleanup	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan								
Eighty Mile Beach									
Migratory birds									
Mangroves								N/A	
Tidal creeks								N/A	
Turtle nesting beaches									
Wetlands/ salt marshes								N/A	
Dampier Archipelago									
Mangroves								N/A	
Turtle nesting beaches									
Corals						N/A	N/A	N/A	
Marine habitat						N/A	N/A	N/A	
Birds									
Cultural values									

Montebello Islands									
Turtle nesting beaches									
Mangroves								N/A	
Corals						N/A	N/A	N/A	
Seabirds									
Barrow Island									
Bird habitat at Bandicoot Bay and Double Island								N/A	
Seabirds									
Turtle nesting beaches									
Mangroves								N/A	
Tidal creeks								N/A	
Marine habitat						N/A	N/A	N/A	
Lowendal Islands									
Turtle nesting beaches									
Mangroves								N/A	
Corals						N/A	N/A	N/A	
Seabirds									
Marine mammals (dugongs, dolphins)						N/A	N/A		
Marine habitat						N/A	N/A	N/A	

Legend	
*	The potential impact of chemical dispersant addition based on analysis presented in Section 7.5.4
	Beneficial impact
	Possible beneficial impact dependent upon the situation (e.g. Timeframes and metocean conditions to dilute entrained oil)
	Negative impact
N/A	Not applicable for the environmental value

7.5.7 Spill Response Strategies

There are numerous oil spill response strategies available to be implemented in the event of a spill. These are generally based on strategies which have been implemented in the past or are considered to be good industry practice.

The evaluation of the suitable response strategies was conducted based on the credible spill scenarios identified and Table 7-11 is the outcome of the first level screening undertaken. Below are the key considerations for the evaluation:

- The properties and weathering profile of the oil;
- The philosophy of the responses, that is, what is aim of the response based on the hydrocarbon properties. In the case of Stag crude: prevention of shoreline contact and application of chemical dispersant to entrain and enhance biodegradation;
- The net environmental benefit of undertaking the response strategy;
- The nature and scale of the maximum credible worst-case scenario; and
- The potential safety and environmental aspects and impacts involved with the selected responses.

Table 7-11: Spill response strategies considered for the mitigation of contact from hydrocarbon spills

Strategy	Description	Benefits and Drawbacks	Decision
Source control	Implementation of the support vessel and MODU SOPEPs	Cease loss of containment event as soon as practicable and reduce the volume of oil entering the marine environment	Adopt
Operational Monitoring	Surveillance actions are used to monitor and evaluate the trajectory and fate of the released hydrocarbon, to determine the effectiveness of response strategies and to identify and report on any potential/actual contacts to flora, fauna, or any other sensitive receptor that occurs. Surveillance results are used to assist in escalating or de-escalating response strategies as required.	There are various specific control measures (vessel/ aerial surveillance, tracking buoys, oil spill modelling, fluorometry) within this response strategy which may be suitable. Their use, in combination or individually, will be determined based on the spill distribution as well as other considerations such as access to locations, environmental and metocean conditions. This strategy is vital to ensure that there is sufficient information to gain situational awareness and make informed decisions on response planning, execution and termination.	Adopt
Chemical dispersion (Secondary strategy)	Chemical dispersant is applied to break down the hydrocarbons and allow/enhance dispersion into the water column, thereby preventing/reducing potential shoreline contact and increasing biodegradation.	Surface chemical dispersant may be viable as aerial application. Based upon previous dispersant efficacy testing undertaken on Stag crude, there is a Window of Opportunity (WoO) up to 72 hours post spill, prior to Stag crude weathering beyond the ability of potential effective chemical dispersion, in which surface chemical dispersant could be applied (refer Section 10 of the OPEP). Chemical dispersants applied at sea surface can reduce the amount of floating oil but increase the oil concentrations in the water column, thereby increasing the risk of exposure to organisms that live in the water column (refer Section 7.5.4.3 and Table 7-8). Entrained oil concentrations are not constant; they are subject to frequent fluctuations due to metocean influences, mobility of receptors and the dilution of the dispersed oil by the sea. Subsequent potential contact to organisms in the water column and nearshore marine habitats is infrequent, of varying concentration, duration and consequence. Therefore, Jadestone consider that any potential shoreline loading reduction is more beneficial than the potential impact to organisms from entrained oil and this strategy is worth keeping in the toolbox as an option. Chemical dispersion will only be undertaken when there is a net environmental	Adopt

Strategy	Description	Benefits and Drawbacks	Decision
		benefit. Applicability of chemical dispersant is limited to the conditions, locations and circumstances described in the OPEP.	
Physical dispersion	Physical dispersion is undertaken by running vessels through the hydrocarbon plume and using the turbulence developed by the propellers or hydro-blasting from vessel hydrants to break up the slick. Once dispersed in the water column in the form of smaller droplet sizes, biodegradation processes are enhanced.	In general, this strategy is considered an opportunistic strategy; used on targeted, small, breakaway areas, especially patches close to shorelines. Given that oil is expected to emulsify by the time it approaches shorelines, and chemical dispersant application would be preferred as a means of dispersing bulk oil; this strategy has limited effectiveness, and is not considered to be a strategy requiring further planning and associated control measures.	Reject
Containment and recovery	Containment and recovery of hydrocarbons can offer a preventive form of protection to sensitive receptors. Skimmers (mechanical) and booms will be used at sea. This strategy is only effective in calm conditions.	For a spill of Stag crude, this is the preferred way to remove hydrocarbons from the water surface before the risk of contacting shorelines/sensitive receptors. Containment and recovery may be applicable once evaporation of highly volatile components has occurred. Based on the Stag crude oil assay, a solidified residual is expected which can be collected using containment and recovery methods. Given that shoreline booming and shoreline clean-up are expected to be difficult across some locations within the EMBA (e.g. Dampier Archipelago and the Montebellos) this strategy is considered important to the overall spill response.	Adopt
Protection and deflection	Protection and deflection activities involve the use of booms to: 1. Protect sensitive receptors; 2. Deflect spills away from sensitive receptors or shorelines; or 3. Deflect spills to an area that provides increased opportunity for recovery activities. This strategy is typically not effective in areas experiencing large tidal variations and associated currents.	Activities are focused on areas of high protection value in low energy environments based upon real time operational surveillance provided the environmental and metocean conditions are favourable for an effective implementation. Consequently, this strategy may not be applicable across all shorelines identified as being contacted by oil.	Adopt
Shoreline clean-up	During a spill response, clean-up of the oiled shorelines will be implemented using suitable methods, provided it will be beneficial to the environment based on the NEBA performed on the affected areas based on actual site conditions.	Contacted shorelines will be assessed for their shoreline clean-up potential. This response has the potential to cause secondary disturbance associated with the clean-up, so applicability of the strategy is based on aerial surveillance reconnaissance, shoreline assessments and NEBA in the shoreline clean-up assessment.	Adopt

Strategy	Description	Benefits and Drawbacks	Decision
Oiled wildlife response (OWR)	Responding to an oiled wildlife incident will involve an attempt to prevent wildlife from becoming oiled and/or the treatment of animals that do become oiled.	Within the EMBA, areas with importance for wildlife have been identified to be threatened by the oil spill and mobilisation of a wildlife response will likely be necessary. Mobilisation of experts, trained work forces, facilities and equipment will then be needed. Wildlife response activities may take place at sea, on shorelines and in specialised facilities further inland. Options for wildlife management are considered and a strategy determined guided by the Western Australian Oiled Wildlife Response Plan (WAOWRP).	Adopt
In-situ burning	In situ burning is a technique sometimes used in responding to an oil spill. In situ burning involves the controlled burning of oil that has spilled (from a vessel or a facility), at the location of the spill. The oil has to be amenable to lighting e.g. unweathered, high lighter oil fractions and not prone to emulsification. When conditions are favourable and conducted properly, in situ burning will reduce the amount of oil on the water.	Operational and oil constraints expected during a spill from the Stag Operations suggest in-situ burning is not applicable. For in-situ burning to be undertaken, oil has to be thicker than 1-2 mm but marine diesel tends to have high evaporation rate and spreads into very thin films rapidly. Stag crude is a highly weathered oil, with little light fractions and prone to emulsification. In addition, in-situ burning requires containment. Due to operational constraints and the expected hydrocarbon not being suitable for in-situ burning, this response strategy is deemed inapplicable for Stag Operations.	Reject
Scientific Monitoring	This is the main tool for determining the extent, severity and persistence of environmental impacts from an oil spill and allows operators to determine whether their environmental protection outcomes have been met (via scientific monitoring activities).	Scientific monitoring is especially beneficial for monitoring entrained and dissolved oil impacts as response strategies are generally targeted to manage the surface oil impacts.	Adopt

7.5.8 Environmental Performance

EPOs and control measures for oil spill response activity implementation are presented in Section 12 of the OPEP.

Environmental Risk		**Release of Stag crude (EPU-04a, b, c)**		
Performance Outcome		**No spill of hydrocarbon to the marine environment**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
Unplanned release from MODU collision with conductors				
54	MODU move procedure	- Functioning positioning equipment (DGPS) on MODU - Functioning anchor handling tug vessel (AHTS) for final positioning - Preload method as per underwriter and drilling contractor's Marine Operating Manual (MOM) - Position of infrastructure (platform, CALM buoy, pipelines, subsea wellheads) marked into positioning software. - Surveyor on board MODU during MODU move in. - Wells shut in at surface and process depressurised for rig approach and positioning. - Rig move procedures in place (including minimum 2 support vessels for positioning)	MODU move procedure reviewed and approved by JSE, drilling contractor and surveying company. Realtime display and logging	MODU OIM
55	Tow equipment	Tow equipment certified as fit for purpose. Tow equipment visually inspected by Rig Mover / Tow Master prior to commencement of tow.	Evidence inspection record	Tow Master
56	MODU move conducted as per Marine Operating Manual (MOM)	Minimum bollard pull requirements for AHTS met or exceeded. Weather window acceptable for tow and pre-load phase. Tow vessels inspected by Tow Master prior to commencement of tow.	MOM checklist	MODU OIM
57	Tow Master present during MODU move	Experienced tow master to move the MODU and on board for all transits and positioning.	Master Mariner qualifications and experience	Supply Chain Lead
Unplanned subsea release from loss of pipeline integrity due to dropped object				
33	Personnel aware of roles and responsibilities in the event of a response in accordance with Stag Incident Response Plan (GF-00-PR-F-00041)	Instructs offshore response roles and responsibilities and training requirements, and Spill exercises conducted as part of incident response drills.	Training and induction records	Stag OIM
			Exercise records	Stag OIM Vessel Masters

				OIM
58	Emergency shutdown system tested and implemented in the event of a loss of pipeline integrity	Emergency Shutdown (ESD) push buttons located in the central control room and throughout the CPF, tested and fit for purpose every six months	Audit records confirm standard.	Stag OIM
59		ESDVs are regularly tested and fit for purpose 6 monthly	ESDV Testing records	Stag OIM
60	Emergency pipeline repair plan in place	Emergency Pipeline Repair Plan (GF-09-PLN-L-00039) is valid and approved prior to commencement of any drilling activity	Controlled document management system records	Stag OIM
61	Post spill scientific monitoring program undertaken	Monitor impacts and recovery of the values and sensitivities identified in this EP in accordance with the OSMP.	Monitoring reports indicate no long-term impacts to the values and sensitivities identified in this EP.	IMT Lead
62	Lifting Procedures	Lifting operations managed in accordance with MODU work instructions or procedures SIMOPS plan and permit to work procedures in place for any starboard outboard lifts (unplanned during the activity).	PTW and SIMPOS procedures in place prior to lifting	MODU OIM Stag OIM
63	MODU Safety Case	MODU Safety case includes controls for dropped objects including: ● Heavy lift procedures ● Lifting equipment is maintained in accordance with manufacturer specifications, certified and inspected ● All personnel involved in lifts are competently trained ● MODU port forward crane is used for outboard lifts as there is no subsea infrastructure to the east of the MODU	NOPSEMA approved safety case implemented	Drilling Manager

7.5.9 ALARP Assessment

All safety options have been considered for the Stag drilling activity with no additional safety options possible, it is considered that the risk of a loss of containment occurring has been reduced to ALARP. The combination of the standard controls (which reduce the likelihood of the event happening), and the spill response strategies (which reduce the consequence) together aim to reduce potential impacts from a hydrocarbon spill. An oil spill response workshop was undertaken and a summary of the rationale behind the spill response measures selected is provided in Table 7-11.

Vessel Collision Control

Vessel activities are required to undertake the activity and cannot be eliminated. The Stag facilities are marked on Australian Hydrographic Service Nautical Charts which identifies the location of the CPF berthing activities to other sea users, and the MODU will be within the existing 500m exclusion zone, and marked on charts. Collision prevention equipment (i.e. navigation and radio equipment) and seagoing qualifications used on vessels/ MODU comply with applicable AMSA Marine Orders which enact the International Convention of the Safety of Life at Sea (SOLAS) 1974 through the Navigation Act 2012. These requirements reduce the risk of errant vessel collisions and the potential for crude oil release from these vessels.

For vessels engaged in operational activities within the 500m zone, the procedures outlined in the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) provide controls to reduce the risk of collision. Communication is established between third party vessels and the CPF well before they enter the Operational Area to ensure proposed activities are safe to proceed and to reduce the potential for vessel collision during simultaneous operations.

Controls are in place (refer Section 7.5.8) which reduce the likelihood of spill events. There are no further controls that are considered to provide a net benefit in reducing the likelihood or consequence of a release of Stag crude to the marine environment and thus, the controls are considered ALARP.

Dropped Object Control

Dropped objects under/through the drill floor, such as BOP, conductor, HP riser, LP riser, will land within the CPF footprint (topsides) within the wellbay, as the MODU will be cantilevered over the Stag CPF and therefore impact with subsea infrastructure is not credible. The MODU port forward crane normally used for outboard lifts and bunkering. As there is no subsea infrastructure to the port/east of the MODU there is no risk to subsea infrastructure during routine lifting.

The starboard crane can be used for outboard lifts but it is used only in exceptional circumstances due to its less than favourable location and the fact that the bulk transfer manifold on the starboard side was decommissioned several years ago. Although the slew radius of the starboard crane is not over the export pipeline, the pipeline is within the drop cone of the starboard crane at its extreme limits. In the unlikely event the starboard crane is used for an outboard lift the activity will be controlled under a SIMOPS PTW.

No anchors will be onboard the MODU to further limit the potential for large dropped objects.

Wells are shut in at the surface and production depressurised during rig move on/off. Being liquid filled the pipeline is effectively depressurised to its hydrostatic head when the process is shutdown. Therefore in the event of a loss of pipeline integrity this would result in a finite volume being released from the pipeline. Depressurising the whole pipeline is therefore not considered ALARP as this would not change the worst case spill scenario of the full pipeline inventory volume.

Flushing the pipeline with seawater is not considered ALARP as this would reduce the oil inventory in the pipeline but due to the nature of Stag crude a significant volume would remain. Flushing would require approximately 6 hours of production shutdown. The offtake tanker would need to be willing to take the flush water and its management creates an additional environmental discharge of (treated) oily water. Given the very low likelihood for the spud can to impact the export pipeline during rig move on/off (the MODU would need to be out of position by more than 30 m during the rig move), the extensive controls in place during rig move (collision with the platform is safety MAE), the effectiveness of the flushing and the cost, both in production and added environmental discharge, flushing is rejected as an additional control for ALARP.

Spill Response Controls

For a Level 1 crude oil spill, containment and clean-up is assisted through the bunding system provided around drilling equipment and the regular inspection programs. Spills are responded to as per emergency and spill response procedures which are practised through regular spill/ emergency response drills on the rig and vessels. In the event that marine diesel or crude oil is not contained through the barriers and procedures onboard the rig (Level 2 spill event), the Stag Drilling OPEP (GF-70-PLN-D-00001), which outlines the detailed response and logistical requirements necessary to combat a WCS, will be implemented to reduce the impacts of a crude oil spill to ALARP. A Net Environmental Benefit Analysis (NEBA) will be used to determine which spill response strategies are appropriate for a given spill scenario and is an integral part of the IAP process.

In the case of any spill to the marine environment, source control and operational monitoring activities will be implemented. The spill response strategies considered for a Level 2 spill are shown in Table 7-11.

The spill response strategies have undergone a robust evaluation and environmental risk assessment process (refer Figure 5-4). The applicability of the control to the spill scenario, and establishing requirements for each control to ensure its effectiveness in meeting the EPO was also undertaken.

The ALARP assessment for the level of resourcing required for each of the spill response strategies adopted is provided in Table 7-12, based on the capability described in the OPEP. This considers the incremental benefit of increasing resourcing levels for each spill response strategy and the associated upfront costs. The effectiveness of each of these response strategies has been increased to a point where further sacrifice made would result in a disproportionately small reduction in environmental risk/impact managed.

From this assessment, it is considered that through the resourcing arrangements outlined within the OPEP (including spill response equipment and personnel from internal and external sources including via the AMOSPlan, AMSA, other operators and other national suppliers) the spill response strategies and control measures reduce spill risk to ALARP. As a member of an industry-wide oil spill response organisation (AMOSC) as a party to a Master Services Contract (MSC) with AMOSC for services for training purposes or in response to a threatened or actual oil spill (Mutual Aid resources, the AMSOC Core Group), a party to an MOU with AMSA for support for oil spill preparedness and response, Jadestone has access to sufficient response capability to reduce the environmental risk to ALARP.

Table 7-12: ALARP assessment for the level of resourcing available for spill response strategies

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
Source Control Section 8 of OPEP	Reduce volume or speed of spill entering marine environment.	The rig and vessel have the response capability as described in the SOPEP and geared towards a Level 1 incident. The SOPEP is to provide shipboard notification and response procedures for stopping or minimizing the unexpected discharge of oil from a rig/vessel without compromising the safety of the crew, the rig/vessel or the environment. Unexpected discharge includes the discharge of oil during rig/vessel operations, or rig/vessel casualty. Significant cost would be incurred for Jadestone to alter the contractual arrangements with the Drilling Contractor to increase capability with consideration for equipment, storage, maintenance, crew training and safety of crew when deploying gear.	It is consistent with the National Plan that rigs/vessels have a level 1 capability. For Jadestone to increase the rig/vessel response capability to a Level 2 would be a disproportionate benefit for the effort. In addition, the worst-case spill results from a vessel collision and the priority of the vessel master is to safeguard the crew and remove all non-essential personnel. Therefore, there is no value in supplementing the vessel SOPEP capability, and therefore the arrangements described in the OPEP are considered ALARP.
Aerial surveillance Section 9.4.3 of OPEP	The benefit of additional flights would be to increase identification of marine fauna presence. The two passes per day separated by six hours' routine allows for the greatest opportunity to sight any slick, allows for coverage of oil movement and to monitor for presence of marine fauna.	Additional charter costs would be incurred by Jadestone to increase from two passes per day. There may be a need for additional resources if determined through the IMT based on the amount of available information and potential data gaps. These can be arranged without need for further upfront costs or planning.	Aerial surveillance is not the only dedicated surveillance tactic. Opportunity for surveillance will also occur from responder movements and opportunistic aerial surveillance through the shared use of aircraft deployed for other purposes. The spatial extent of the spill is more dependent on tidal influences than the wind. Tides are twice per day and are best captured by twice daily aerial flights. The two dedicated passes are sufficient to validate and inform the IAP process and monitor fauna presence to ensure overall response is commensurate with nature and scale of incident.

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
	The morning pass will validate the current IAP and the second afternoon pass will inform the development of the next IAP operational period. This will be used along with the other surveillance tactics (e.g. trajectory modelling, tracker buoys and fluorometry).		Therefore, there is no value in increasing dedicated overpasses and therefore the arrangements described in the OPEP are considered ALARP.
Vessel surveillance Section 9.4.2 of OPEP	One dedicated resource within 48 hours is considered ALARP. There would be no environmental benefit for additional dedicated resources given the need is met through vessel sharing and surveillance will also be conducted through a number of complementary operational monitoring strategies (aerial surveillance, tracker buoys).	In the event that additional dedicated vessels are required due to data gaps, resources are available. The cost of the additional vessels will be added to the cost of the response.	There is no benefit in having additional dedicated surveillance vessels given surveillance can be performed from any vessel and these duties will be shared amongst spill response vessels. Vessel surveillance is of more value to identify marine fauna presence. Marine fauna congregates around the Stag platform and can be easily seen from there, the MODU and support vessels. Aerial surveillance, tracker buoys and UAVs are more efficient and effective at determining extent of oil movement, vessel surveillance is a secondary tactic. Therefore, there is no value in increasing dedicated vessel numbers and therefore the arrangements described in the OPEP are considered ALARP.
Tracking buoys Section 9.4.1 of OPEP	The buoys will be deployed within one hour and then 24 hours of spill release. As the spill is instantaneous and of a defined volume, there is no additional benefit to increasing tracker buoys.	Additional buoys are available through AMSA and AMOSC within days. There is no additional upfront cost for accessing these secondary buoys.	Tracking buoys are one tactic in the operational monitoring strategy. The number of buoys immediately available is sufficient to cover tracking of oil given the worst-case spill is a defined volume and timeframe. Placing an additional tracker buoy on the MODU would have no additional benefit than from the CPF as the distance between the MODU and CPF is small and subject to same tidal influences. Also, tracker buoys require maintenance which can be scheduled from the CPF as part of the spill response equipment. Therefore, there is no value in increasing tracker buoy numbers and therefore the arrangements in the OPEP are considered ALARP.

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
Fluorometry Section 9.4.6 of OPEP This remains the same unless Jadestone changes service providers	The purpose of fluorometry is to: 1) inform the scientific monitoring; 2) provide validation for trajectory modelling predictions. Additional fluorometers may limit missed data opportunities. Fluorometry will target subsea plumes approaching those sites that have the greatest potential for environmental impact (i.e. the most sensitive areas with the highest predicted concentration of entrained oil). Any additional fluorometers would be deployed to other sensitive areas in the EMBA and once those fluorometers have confirmed presence of entrained oil, these units can be moved to other areas. Therefore, it is considered there is little additional environmental benefit in having more fluorometers. Access to vessels for towing (small vessels) will be per the Logistics Management Plan.	Jadestone can access 2 fluorometers through Jacobs and additional fluorometers through CSIRO. This is considered sufficient for upfront planning. Additional tow behind fluorometers can be sourced from CSIRO if apparent there are data gaps that can't be filled by existing arrangements. This would not be an upfront cost but the need and costs would be assessed after a spill event.	The existing arrangements are considered sufficient to meet fluorometry purpose. Additional fluorometers can be arranged and deployed should the need arise this is not considered time critical and the additional benefit is considered low. Therefore, there is no value in increasing fluorometery numbers and therefore the arrangements described in the OPEP are considered ALARP.
UAVs Section 9 of OPEP	UAVs can monitor in difficult to access areas and prevent unnecessary intrusion by responders. Information is real time and utilised in the IAP for targeted response. UAVs allow more data	There would be additional cost in obtaining more than the four UAVs outlined in the OPEP, also for additional vessels and personnel to interpret data.	The resourcing provides UAV capability for each Protection Priority (with 4 deemed sufficient to cover Dampier, 80 Mile Beach, Barrow, Montebellos and Lowendal Islands). Additional UAVs will not provide additional benefit (except for redundancy). The UAVs are considered a secondary aid in locating oil in difficult terrain.

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
	captured quicker than by deploying responders alone. There is no environmental benefit from additional UAVs as the Protection Priorities are covered by four.		Additional UAVs can be sourced as needed after a spill event given their high availability. The number outlined in the OPEP is for pre-deployment planning purposes only. Given the use of UAVs is a secondary strategy and not critical to reducing environmental impact the existing arrangements described in the OPEP are considered ALARP.
Shoreline and coastal habitat assessment using SCAT surveys. Section 9.4.7 of OPEP	Shoreline Cleanup and Assessment Technique (SCAT) is a systematic method for surveying an affected shoreline after an oil spill. SCAT is designed to support decision-making for shoreline cleanup. It is flexible in its scale of surveys and in the detail of datasets collected. SCAT continues during the response to verify shoreline oiling, cleanup effectiveness, and eventually, to conduct final evaluations of shorelines to ensure they meet cleanup endpoints.	The cost of additional resources is not considered the limiting factor; the limiting factor is the availability to use resources at the physical location. Additional people from described in the OPEP could cause unnecessary environmental impacts. If required, additional equipment will be sourced and the additional cost borne by Jadestone.	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP). SCAT numbers are not cumulative as this data represents stochastic modelling outputs. A spill would not contact all receptors modelled and not all at once. Then number required would be based on direction of spill and timeframes to contact. Capability required is 5 teams across the 5 priority receptors with 3 people per team. The existing arrangements are considered sufficient to meet SCAT purpose. Additional personnel can be sourced and deployed should the need arise; this is not considered time critical and the additional benefit is considered low. Therefore, there is no value in increasing SCAT numbers and therefore the arrangements described in the OPEP are considered ALARP.
Chemical dispersant application Section 10 of OPEP	Implementing a faster application timeframe has the potential for further reduction of floating oil and shoreline loading (reducing/eliminating further environmental impacts - clean-up and protection and deflection intrusions, oiled wildlife) and an increased ability of the environment	Dispersant application can commence within 18 hours (operations only occur during daylight hours) of activation. Quicker application would only be possible if in-field support vessels were equipped with dispersant, dispersant application equipment and supported by trained personnel. However, there are limited times where in-	The worst-case spill scenario where chemical dispersant is recommended is an instantaneous spill from the MODU conductors, with a finite volume of oil 68 m^3. Due to the relatively small spill volume, a small volume (5.4 m^3) of dispersant is required and can be met by Day 2 via aerial application. To apply dispersant quicker would require hiring a dedicated in-field support vessel for dispersant application, purchasing of additional dispersant, application equipment and the costs of training multiple vessel crew members or employing dedicated trained personnel to be available at all times on the in-field support vessel.

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
	to biodegrade the oil more rapidly to below threshold levels; thus, reducing the severity and duration of the spill and subsequent economic and social impacts such as beach tourism. A negative consequence is the further increase in localised entrained and dissolved oil concentrations with subsequent risk of additional environmental impacts to organisms in the water column (refer Section 7.5.4 and Table 7-8). This could have negative flow-on social and economic consequences e.g. recreational and commercial fishing, diving.	field support vessels are in transit to port or on hire elsewhere, so worst-case timing would be 3-5 days, meaning aerial application would be quicker. To ensure vessel dispersant application would commence quicker than aerial application at all times would require a dedicated in-field support vessel for dispersant application. The maximum volume of dispersant that can be applied within the activity timeframe has been calculated to be 5.4 m^3. Dispersant costs approximately $10,000/$m^3$. In addition to this cost would be the cost of having multiple crew members or dedicated personnel trained in vessel dispersant application (to cover rotational shifts) on the vessel at all times.	The estimated Window of Opportunity (WoO) for chemical dispersant application diminishes after 72 hours. Jadestone has evaluated that the earliest chemical dispersant operations can commence is 18 hours after a spill (refer Section 10 of OPEP). This would enable dispersant application to oil within the WoO and does not compromise the effectiveness of other strategies. Given dispersant application can already occur within the WoO, the relatively small volume of dispersant that is required and that chemical dispersants are a secondary response strategy, the cost of hiring and equipping in-field support vessels and training personnel to undertake more rapid dispersant application is disproportionate to the benefit that may be gained. Controls placed on chemical dispersant application (Section 7.5.8 of the EP and Table 16-1 of the OPEP) are in place to ensure environmental risk is reduced to ALARP.
Containment and recovery Section 11 of OPEP	By increasing the recovery of oil off the water, less is able to contact shorelines thereby reducing potential environmental impacts. Additionally, shoreline waste volumes and associated environmental impacts on shorelines is reduced.	Approximate costs: Vessels $15,000 each per day plus $1,600 per day for fuel Boom hire $12,000 per day for 6 teams. 6 skimmers $6,000. Additional personnel $1,500 per day	Containment and recovery operations will be focussed on the trajectory of the spill. Operations will focus on the Protection Priorities (as the most commonly contacted and environmentally valued locations across all modelled scenarios) and the need is met by the access to resources as described in the OPEP. Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer Section 11 of OPEP). It was found that 2 containment and recovery teams (4 vessels, 2 skimmers,

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
			400 m boom) are estimated to contain and recover up to 56.4 m^3 of oil per day. This is more than sufficient to recover the oil available from weathering from the worst-case spill. Jadestone could mobilise additional containment and recovery teams to the spill site, however this is likely to be ineffective, given that containment and recovery is not an efficient strategy (usually limited to between 5% and 20% of the initial spilled volume (IPIECA-IOPG, 2015)). Jadestone could purchase and maintain suitable vessels and equipment to be on standby 24/7/365, however this is cost prohibitive and disproportionate to the risk. In addition, it is not feasible to pre-deploy containment and recovery equipment as modelling identifies different potential shoreline contact locations (depending on the season) which are, largely remote and uninhabited. Even when the Protection Priorities are focussed on (as being the most commonly contacted locations across all modelled scenarios), the intrusion caused by equipment deployment and maintenance (considering the continuing operational aspect of Stag (24/7/365) would result in unnecessary additional impact to these locations and potential safety risks. In addition, the cost of doing this is disproportionate to the benefit. The current level of resources meets for the need as it allows flexibility in response operations as not all locations will be contacted in a single spill event. Containment and recovery arrangements described in the OPEP are considered ALARP.
Protection and Deflection Section 12 of the OPEP	Additional Protection and Deflection resources reduces shoreline contact and accumulation of oil, and subsequent impacts to shorelines. However, additional resources on shorelines will increase potential	Boom hire costs are variable depending on the configuration and type used however they are estimated to be approximately $5,000 per day. The cost of additional resources is not considered the limiting factor; the limiting	Protection and deflection has limited application for some locations due to tidal influences and lack of anchoring points for booms. Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP Section 12).

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
	environmental contact and intrusion opportunities and increase safety risks of responders.	factor is considered to be the availability to use resources at the physical location. If required, additional equipment will be sourced and the additional cost borne by Jadestone.	For Jadestone to purchase equipment and store and maintain is cost prohibitive when access via AMOSC will meet the need, and the limiting factor is people (who are accessed from outside Dampier). It is cost prohibitive and disproportional to the risk for Jadestone to purchase and maintain equipment to be on standby 24/7/365 when access to vessels and equipment is possible through contracts and AMSOC. Vessels and people will be utilised as determined through the IAP and NEBA. Given the remoteness of the locations with shoreline contact modelled and continuing operational aspect of Stag (24/7/365) there is considered limited benefit for pre-deployment of resources as this would create unnecessary long-term environmental disturbance (both for placement of resources and continuing maintenance) and unnecessary safety risks. In addition, the cost of doing this is disproportionate to the benefit. The current level of resources meets for the need as it allows flexibility in response operations as not all locations will be contacted in a single spill event. Therefore, the arrangements described in the OPEP are considered ALARP.
Shoreline Clean-up Section 13 of the OPEP	While oil is arriving there is limited benefit from additional resources that might remove oil more quickly and any additional resources may be counterproductive in that additional impacts may outweigh benefits. After the oil has finished arriving, there may be an additional benefit in having increased resources at particular locations dependent upon environmental considerations. For example a turtle nesting beach during the nesting/hatching season	The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the ability to use resources at the physical location. If required, additional personnel and machinery will be sourced and the additional cost borne by Jadestone.	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP Section 13). Intrusive shoreline clean-up techniques (e.g. mechanical and manual removal) have the potential to damage sensitive shorelines. Given that the majority of protection priorities predicted to be contacted have mangroves and species sensitive to shoreline clean-up activities (e.g. nesting birds) the appropriateness of clean-up will be determined via NEBA (as opposed to natural attenuation). It is therefore the opportunity for use rather than the availability of machinery and personnel which is considered the limiting factor to increase shoreline clean-up capability. In addition, volumes predicted ashore from spill modelling indicate 2-33m^3

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
	may benefit in having additional resources deployed to clean the beach before nesting/hatching events. However, additional resources on shorelines will increase potential environmental contact and intrusion opportunities, increase safety risks of responders, cause physical damage and could be a negative impact.		accumulated oil on shorelines above 100g/m^2 in the worst replicate. For Jadestone to purchase equipment, store and maintain it is cost prohibitive when access via AMOSC Mutual Aid and mainstream suppliers will meet this need, and the limiting factor is people (who have to be accessed from outside Dampier), health and safety issues for shoreline work and suitable vessels. Given the remoteness of the locations with shoreline contact modelled and continuing operational aspect of Stag (24/7/365) there is considered no benefit for pre-deployment of resources as this would create unnecessary environmental disturbance (both for placement of resources and continuing maintenance) and unnecessary safety risks. In addition, the cost of doing this is grossly disproportionate to the benefit. The current level of resources meets for the need as it allows flexibility in response operations as not all locations will be contacted in a single spill event. The arrangements described in the OPEP are considered ALARP.
Waste Management	Additional resources for waste management would have a benefit for reducing secondary contamination. However, additional resources in waste zones will increase potential environmental contact and intrusion opportunities, increase safety risks of responders, cause physical damage and could be a negative impact.	Additional cost would be incurred for additional laydown zones, decontamination areas, receptacles, PPE, people, transport and access to facilities.	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP). Additional resources can be sourced through existing arrangements with NWA if during a response it becomes apparent that additional resources are required. Planned resources are considered to match worst-case modelled waste requirements. Increased resources will have additional stressors and potential negative impact to the environment and operational area. The arrangements described in the OPEP are considered ALARP.
OWR Section 14 of	The OWR level is a Level 3 (refer WAOWRP and POWRP) as Eighty	Significant additional cost would be incurred if Level of response increase to	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event

Strategy tasks and resources arrangements	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment
the OPEP	Mile Beach has been identified as a Protection Priority. OWR aims to prevent/reduce the impact to marine fauna (in particular birds and turtles) and any long term effects.	Level 4 or above in particular around the people and facility aspect. Significant additional cost would be incurred if Jadestone provided its own oiled wildlife response (personnel, experts, facilities, plans etc).	(refer OPEP). Additional strategies that have been considered include: ● Additional arrangements to improve mobilisation times of international OWR resources (e.g. additional contracts/arrangements with OWR organisations or pre-mobilisation of international OWR personnel) ● Additional training of Australian based OWR personnel to increase numbers of competent OWR personnel Given the local (AMOSC and DBCA) and global (OSRL/Sea Alarm) response capability through existing arrangements could be mobilised within required timeframes, the response arrangements are considered ALARP as these plans are contextualised for the Pilbara. The WAOWRP and the POWRP were developed by the State environmental agency in conjunction with industry, Perth Zoo and academia. Therefore, represents the best-oiled wildlife response plans that WA and Jadestone can utilise. The level of oiled wildlife response required for a worst-case impact event was considered to be potentially a Level 3 based on worst-case population density and distribution of shorebirds and an examination of applicable case studies of similar characteristics (i.e. Macondo). The arrangements of OWR outlined within the OPEP are considered sufficient for a controlled escalation of response prior to the worst-case minimum contact times for oil at the sites of highest abundance and sensitivity (i.e. Eighty Mile Beach) Stag crude is not toxic and has low adherence properties, but it is persistent. The arrangements described in the OPEP are considered ALARP.

7.5.10 Acceptability Assessment

The potential impacts due to an unplanned release of Stag crude oil are considered to be 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices at the Stag facility, including spill response arrangements.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), including engagement with the State and National response agencies of DoT and AMSA, AMOSC, nearby operators, as well as commercial and recreational fishing industry bodies and fishers. No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Laws and standards	Jadestone is obligated to respond to a hydrocarbon spill under the following legislative instruments: ● OPGGS Act Section 572A-F – polluter pays for escape of petroleum) ● AMSA Marine Orders Part 91 ● Protection of the Sea (Prevention of Pollution from Ships) Act 1983 ● Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008
Industry best practice	Response planning and preparedness undertaken in accordance with: ● National Plan for Maritime Environmental Emergencies (AMSA, 2020) ● AMOSPlan (AMOSC, 2017) ● NOPSEMA Guidance Notes (e.g. Oil Pollution Risk Management Guidance Note July 2021) ● DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangement July 2020 ● State Hazard Plan – Maritime Environmental Emergencies (MEE), 2021) ● Fingas, M.F. (2012) The Basics of Oil Spill Clean-up. CRC Press. Florida, United States of America. ● ITOPF Technical Information Papers including: ○ ITOPF (2014) Technical Information Paper Dispersant Use ○ ITOPF (2020). ITOPF Members Handbook 2020/2021 ○ ITOPF (2014) Technical Information Paper Clean-up of oil from shorelines ○ ITOPF (2013). Technical Information Paper Use of Booms in oil pollution response · ● IPIECA International Association of Oil and Gas Producers Good Practice Guide Series including: ○ IPIECA-IOGP. (2015) A Guide to Oiled Shoreline Clean-up Techniques: Good practice guidelines for incident management and emergency response personnel ○ IPIECA-IOGP (2015) Oil spill preparedness and response: an introduction ○ IPIECA-IOGP (2015) Contingency planning for oil spills on water Good practice guidelines for the development of an effective spill response capability ● Oil Spill Response (OSRL) handbooks including: ○ Shoreline operations handbook ○ Containment and recovery handbook ● Dispersant application field guide
Environmental context	The worst-case credible Stag crude spill scenario for the drilling activity is as a result of damage to MODU conducctors. The worst case release of oil occurs over 5 hours and the area of dispersion over which the oil travels is between Eighty Mile beach to the north and

	Ningaloo in the south. The oil is primarily floating and sensitive receptors at risk include seabirds, shorebirds, marine fauna and coastal habitats. While some response strategies (e.g. application of chemical dispersants and booming operations) pose risk to sensitive receptors, to not implement response activities would likely result in greater negative impact to the receiving environment and a longer recovery period. The mutual interests of responding and protecting sensitive receptors from further impact due to response activities is managed through the use of the net environmental benefit analysis during response strategy planning in preparedness arrangements as well as during a response.
Conservation and management advice	- Jadestone will have regard to the representative values of the reserves and other conservation advice published and endeavor to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state marine parks impacted by unplanned crude release to ensure that the objectives of the management plans are not contravened . - Noting 'Emergency response' is permitted in all AMPs and state marine parks. - Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorized under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. - Protected areas within the RISK EMBA predicted to potentially be impacted by crude above threshold levels have been identified as Priority receptors (Section 7.5.5). - The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/used as guidance in the event of an oil spill. - A number of conservation advice, threat abatement plans and management plans identify marine pollution and/or habitat degradation or modification as a threat. The plans require appropriate mitigation measures to be implemented to prevent impacts to the fauna. These plans are listed in Table 3-5 and include: - - Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) - Recovery plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) - Approved Conservation Advice on *Pristis lavate* (dwarf sawfish) (DEWHA, 2009) - Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015a) - Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (DoE, 2014b) - Approved Conservation Advice for *Pristis zijsron* (green sawfish) (DEWHA, 2008c) - Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a) - Approved Conservation Advice for *Milyeringa veritas* (blind gudgeon) (DEWHA, 2008d) - Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (DEWHA, 2008e) - Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) - Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) - Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) - Conservation Management Plan for the Southern Right Whale 2011 – 2021 (DSEWPaC, 2012h) - Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (DSEWPaC, 2011a) - Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled seasnake) (DSEWPaC, 2011b) - Recovery plan for marine turtles in Australia 2017 – 2027 (DoEE, 2017) - Approved Conservation Advice on *Dermochelys coriacea* (DEWHA, 2008f) - Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) - Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)

	- Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016a) - Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy) (TSSC, 2015i) - Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DoE, 2015c) - Approved Conservation Advice for *Calidris tenuiro*striss (Great knot) (TSSC, 2016e) - Approved Conservation Advice for *Charadrius lesch*enaultii (Greater sand - Approved Conservation Advice for *Charadrius mo*ngolus (Lesser sand plover) (TSSC, 2016d) - Approved Conservation Advice for *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian) (TSSC, 2016c) - National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) - Approved Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015d) - Approved Conservation Advice for the Abbott's booby *Papasula ab*botti (TSSC, 2020a) - Approved Conservation Advice on *Rostratula au*stralis (Australian painted snipe) (DSEWPaC, 2013b) - Approved Conservation Advice on *Sternula nereis nereis* (fairy tern) (TSSC, 2011) - Conservation Advice *Thalassarche cauta* Shy Albatross (TSSC, 2020b)
Australian Marine Parks	Australian Marine Parks are established by proclamation under the *EPBC Act* for the purpose of protecting and maintaining biological diversity in the parks. Environment plan (EP) must be consistent with the Australian Marine Park Management plans. There are 7 AMPs within the RISK EMBAs. In all cases where an activity has potential to impact or present risk to AMPs, regardless of whether the activity is inside or outside a park, the EP should evaluate how these impacts and risks will be of an acceptable level and reduced to as low as reasonably practicable (ALARP). Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones. The requirement is that The Director should be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Consultation to notify the Director of Parks when the proposed response activities is completed as part of the Consultation process (Section 4). The Director notification in the event of a spill that would impact one of the AMPs is included in the OPEP and Implementation section of this EP (Section 9). As such this EP is consistent with the Australian Marine Park Management plans.
ALARP	The residual risk has been demonstrated to be ALARP.

7.6 Unplanned Release of Marine diesel

7.6.1 Description of Hazard

Aspect	This section considers three spill scenarios resulting in the release of marine diesel to the marine environment: 1. Release of marine diesel may occur from a support vessel fuel tank rupture due to platform/ vessel/ MODU collision (150 m^3), 2. Due to a MODU refuelling event (5 m^3), or 3. Due to poor handling and storage of hydrocarbons, equipment failure, refuelling of machinery from

	day tank (500L).

Marine diesel is stored on the rig and is the main fuel source for support vessels. A HAZID was undertaken for the Stag drilling activities and the below credible scenarios resulting in a marine diesel spill were identified (Table 7-13).

Table 7-13: Credible marine diesel releases to the marine environment

Scenario	Maximum Credible Spill	Credibility justification
Release of marine diesel from support vessel fuel tank due to vessel collision with the CPF / other vessel / MODU	Based on AMSA (2015) 'other vessel collision' – volume of largest fuel tank = **80m^3** (based on a typical operations support vessel); **150 m^3** (based on a typical maintenance support vessel)	AMSA (2015) Indicative maximum credible spill volumes table is directly applicable for determining the volume that may be released in a vessel collision scenario. An operations support or supply vessel would typically carry a total fuel capacity of 320 m^3 in four separate tanks resulting in a maximum credible spill volume of 80 m^3 using a single tank. Of the potential vessels identified, a single wing tank is the largest and has a volume of approximately 110m^3. Most tanks when loaded are generally 80-85% full. To ensure conservatism, the worst case is assumed to be approximately 150m^3.
Leak or rupture of bunkering hose during support vessel to MODU refuelling	Based on AMSA (2015) 'Production platform refuelling – continuous supervision' Transfer rate x 15 minutes (continuous supervision) = 20 m^3/hr for 15 minutes = **5m^3**	AMSA (2015) Indicative maximum credible spill volumes table is directly applicable for production platform refuelling. Continuous supervision is the appropriate credible level of supervision given that transfers are of short duration and refuelling procedures stipulate continuous supervision.
Handling and storage of hydrocarbons, equipment failure, refuelling of machinery from day tank	**500L**	Handling and storage of hydrocarbons, equipment failure, refuelling of machinery from day tank

The HAZID identified scenarios where the event leading to a marine diesel release would not occur, or, where due to the small volumes did not result in the marine diesel being released into the marine environment. These included:

1. Release marine diesel to the marine environment from a leak or rupture to the bunkering hose during marine diesel transfer from vessel to vessel – this is considered not credible for vessel to vessel transfers, as no marine diesel bunkering/ refuelling on location occurs for support vessels.
2. Release of marine diesel to the marine environment from the CPF bulk marine diesel storage tank from a collision with a vessel – the CPF bulk storage tank (inventory of 65 m^3) is enclosed within the hull structure of the CPF which is raised off the sea surface by ~50 m. The CPF is designed to withstand a 2,000 t vessel impacting at 0.5 m/s (typical support vessel at required low manoeuvring speed) so it is not considered credible that the bulk storage tank would be damaged resulting in a release to the marine environment.
3. Release of marine diesel to the marine environment due to vessel grounding – A release of hydrocarbon due to vessel grounding and subsequent fuel tank rupture resulting from a loss of propulsion or due to navigational error resulting in a vessel running aground in shallow areas was not considered a credible scenario for the Stag drilling activity as the operational area is situated in deep water (approximately 50 m) and there are no charted reefs or islands that pose a grounding hazard. This is confirmed by seabed surveys in the operational area and surrounds.

Spill volume

The volume of marine diesel that could be released to the marine environment from vessel collision and subsequent rupture of fuel tank is largely dependent upon fuel tank position on the vessel, and the degree and location of tank damage. The AMSA (2015) guideline: *Technical guidelines for preparing contingency plans for marine and coastal* facilities has been used in determining the potential release volume of the credible scenarios. These calculations provide a spill volume of 80 m^3 for operations support vessels, 150 m^3 for maintenance support vessels, and 5 m^3 during transfer of marine diesel between a support vessel and MODU. For the purpose of determining potential impacts, the larger volume of 150 m^3 has been used as it is considered to be representative of a typical maintenance vessel and subsumes both the 5 m^3 and 80 m^3 scenarios outlined above.

7.6.1.2 Marine diesel Characteristics

Characteristics for marine diesel were extracted from the ASA oil database for similar operational temperatures (Table 7-14). Marine diesel is a mixture of volatile and persistent hydrocarbons with a low percentage of volatiles (6%) and with the greater proportion having moderate to very low volatility (89%). The aromatic content is approximately 3%.

Table 7-14: Characteristics of marine diesel

<table>
<tr><th rowspan="2">Initial Density @ 25°C (g/cm^3)</th><th rowspan="2">Viscosity @ 25°C (cP)</th><th>Component</th><th>Volatiles (%)</th><th>Semi-volatiles (%)</th><th>Low-volatility (%)</th><th>Residual (%)</th><th>Aromatics (%)</th></tr>
<tr><th rowspan="2">Boiling Points (°C)</th><th><180
C4 to C10</th><th>180-265
C10 to C15</th><th>265-380
C15 to C20</th><th>>380
>C20</th><th>Of whole oil
<380</th></tr>
<tr><td rowspan="3">0.829</td><td rowspan="3">4</td><th colspan="3">Non-Persistent</th><th colspan="2">Persistent</th></tr>
<tr><th>% of total</th><td>6</td><td>34.6</td><td>54.4</td><td>5</td><td>3</td></tr>
<tr><th>% aromatics</th><td>1.8</td><td>1</td><td>0.2</td><td>-</td><td>-</td></tr>
</table>

In the marine environment marine diesel will behave as follows:

- Marine diesel will spread rapidly in the direction of the prevailing wind and waves;
- Evaporation is the dominant process contributing to the fate of spilled marine diesel from the sea surface and will account for >50% reduction of net hydrocarbon balance;
- Marine diesel will entrain under the water surface particularly when wind speed and resultant wave action increase;
- The evaporation rate of marine diesel will increase in warmer air and sea temperatures such as those at the Stag location; and
- Marine diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

7.6.1.3 Modelling Approach

To determine the spatial extent that may be affected by a 150 m^3 marine diesel spill released over five hours, historical modelling completed by APASA (2013c) was reviewed. The modelling considered the release of 250 m^3 within the Stag permit area over all seasons of the year and has been reviewed to ascertain the spatial extent of floating and entrained oil above impact thresholds.

A summary of the modelling methods used to evaluate the weathering and distribution of a 250 m^3 marine diesel spill within the Stag permit area are as per those described in Section 7.5.3. Provided below are details specific to the marine diesel spill modelling scenario:

1. **Stochastic approach**: stochastic modelling was carried out with 60 replicate simulations each modelled for six locations within the permit area.
2. **Probability contours**: the results were presented in terms of statistical probability maps based on 360 simulations.
3. **Completion of modelling**: each of the 360 simulations was run for a period of two to three weeks allowing for the fate of dispersed hydrocarbons to be evaluated.

7.6.1.4 Marine diesel Modelling Results

APASA (2013c) modelled the weathering profiles of marine diesel to illustrate the potential behaviour of the fuels when exposed to idealised and representative environmental conditions. The modelling showed that weathering is influenced by the prevailing wind and sea state conditions. Under calm wind conditions (less than 5 knts), entrainment of marine diesel did not occur and evaporation removing approximately 40 per cent of oil within a short duration (days) with the remainder evaporating slowly over time until non-volatile residual remained. Under variable wind conditions (4–19 knots), representing a more realistic condition within the Stag permit area, approximately 50 per cent of the released marine diesel was forecast to evaporate and 45 per cent entrain within days, leaving a small proportion of oil floating on the sea surface. Approximately 60 hours after being released, minimal floating oil was forecast (<2%).

<u>*Spatial extent of impacts (*Figure 7-3*)*</u>

Floating Oil – modelling of a 250 m^3 marine diesel spill predicted that floating oil slicks were most likely to disperse in a north-easterly direction from the spill location, for spills commencing in summer and transitional seasonal months. Floating oil slicks were expected to follow westerly trajectories for spills commencing during winter months. There was no floating oil contact above 1 g/m^2 for any receptor in any season.

Entrained Oil – Based on modelling of a 250 m^3 spill of marine diesel, entrained oil at concentrations >500 ppb could extend up to 70 km from the release point. Modelling of a 250 m^3 release determined maximum entrained marine diesel concentrations in any coastal waters of 841 ppb at Barrow Island, the minimum contact time taking 59 hours to reach the Montebello Islands.

Dissolved Aromatic Hydrocarbons – Representative modelling previously prepared, including modelling of a 329 m^3 marine diesel release at a location approximately 100 km northeast of the Stag Facility (APASA, 2013e) and a larger modelled release of 1,519 m^3 of marine diesel offshore of North-West Cape (APASA, 2013f), did not predict DAH above the contact threshold due to a vessel collision/ marine diesel spill scenario. It is therefore considered that DAH from a 150 m^3 marine diesel release from a maintenance vessel at the Stag Facility will not exceed the contact threshold for DAH (100 ppb).

The extent of impact from floating, entrained and dissolved oil from a 150 m^3 marine diesel release is predicted to be smaller than for the WCS Stag crude spill. This is due to the different properties of Stag crude and marine diesel. Stag crude is persistent in the environment and marine diesel is highly evaporative, easily entrained and dissipated. Therefore, the Stag crude release is the maximum worst case scenario.

7.6.2 Impacts and Risks

Marine diesel oil is a highly volatile hydrocarbon with a high proportion of toxic monocyclic aromatic hydrocarbons (MAHs) that are harmful in varying degrees to marine fauna. Marine diesel contains some heavy components (or low volatility components) that have a strong tendency to physically entrain into the upper water column in the presence of moderate winds (i.e. >12 knots) and breaking waves, and can resurface if these energies abate.

In the event of a substantial marine diesel spill, the heavier components of marine diesel can remain entrained or at sea surface for an extended period. Given the properties of marine diesel, it is expected that marine fauna, marine habitats, protected and significant areas and socio-economic receptors, have the potential to be impacted by surface and entrained thresholds.

See Appendix D and Table 7-8 for more detail on the physical and chemical pathways and oil impacts to habitats, marine organisms and socio-economic receptors and resultant thresholds.

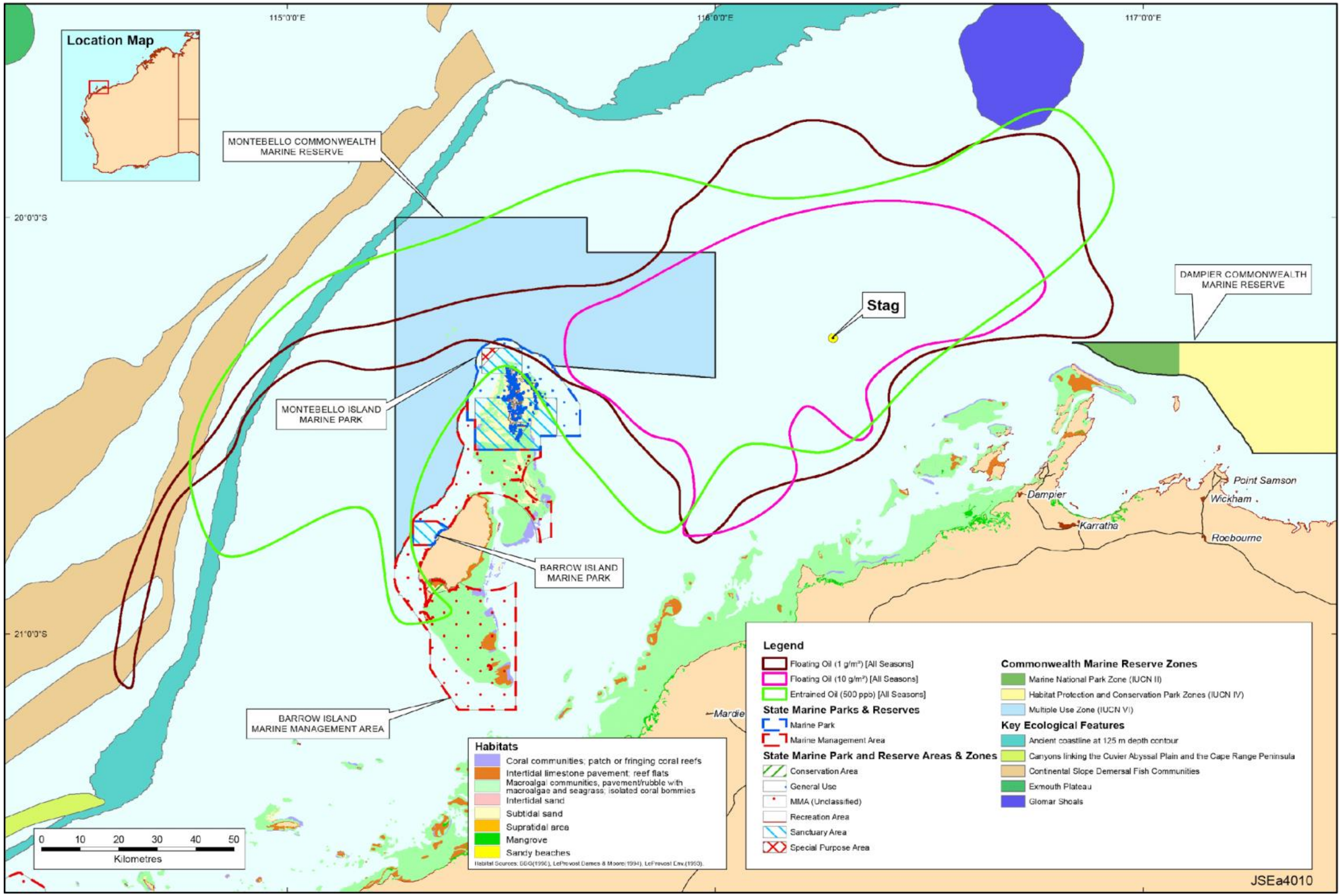

Figure 7-3: **Modelled spill trajectories for all seasons for floating and entrained marine diesel resulting from surface release of 250 m³ marine diesel.**

7.6.2.2 Surface Exposures

Estimates for the minimum oil thickness that will harm seabirds (through ingestion from preening of contaminated feathers or loss of thermal protection of their feathers) are considered to be 10 g/m^2. These hydrocarbon thresholds are also considered appropriate for consequence assessment of turtles, sea snakes and marine mammals (NRDAMCME, 1997) as the exposure pathways and effects are similar (i.e. ingestion and skin irritation) (Appendix D).

The BIA of several EPBC listed species occurs within the EMBA for marine diesel (Table 3-3) which may result in higher numbers of individuals occurring in the area of effect. Habitats that may be contacted by floating oil include sandy shores at the Montebello, Lowendal and Barrow Islands, and the Dampier Archipelago. The Montebello Islands and Barrow Islands make up a protected area and have a management plan that identifies key receptors (refer Section 3.7). Impacts to these receptors from physical contact may include toxic response, such as mortality, reduced growth or reproductive success.

Contact of these receptors may have an indirect effect on socio-economic receptors including fishing and nature-based tourism.

Shoreline habitats – Shoreline habitats which have the potential to be contacted by stranded oil include intertidal coral reefs, cays, sandy shorelines, mangroves, rocky shorelines and intertidal mud/sandflats. Fauna associated with these can be exposed to toxic effects from ingestion as fauna attempt to clean themselves (e.g. preening of feathers or licking fur), reduced mobility and inability to thermoregulate due to oil coating, contact to eyes, noses and breathing apparatus (invertebrates) from oil coating can result in irritation and/or inability to breathe or see.

Corals – Contact of floating marine diesel could occur with intertidal corals at low tide. The degree to which impacts such as bleaching, mortality or reduced growth could occur will depend upon the level of coating (concentration of oil and/or loading of oil on shorelines) and how fresh the oil is.

Prolonged contact of oil with corals has been observed to lead to tissue death and bleaching to exposed parts of colonies. Dosages of entrained aromatic hydrocarbons are not predicted to reach levels where hydrocarbons dissolved under floating oil could impact intertidal or subtidal corals. Since marine diesel is a highly volatile and easily dispersed hydrocarbon, contact with hard intertidal corals is temporary and recovery of intertidal coral communities is expected to be quick. A number of important coral areas could be contacted, dependent upon weather conditions and resultant spill trajectory, including Montebello/ Barrow/ Lowendal Islands and Dampier Archipelago. Coral at these locations have been identified as a KPI in the respective marine park management plans (Table 3-14).

Corals at the Montebello/ Barrow/ Lowendal islands and Dampier Archipelago have the potential to be contacted by the greatest volumes. Impacts to hard corals could be intensified if a spill was to reach shallow coral areas during the peak spawning season of March/ April since floating oil could coat intertidal corals in the process of spawning or could contact floating coral eggs and larvae following spawning events. Dependent on the level of contact, this could diminish coral recruitment, and impact longer term recovery.

Presence of surface oil can affect light qualities and the ability of macrophytes to photosynthesise. Reduced primary productivity could occur while surface oil is present.

Mangroves – Mangrove root systems (including pneumatophores) are sensitive to physical coating by hydrocarbons and there is a tendency for mangrove root habitat to trap oil. This could have prolonged negative effects on the faunal communities within mangroves. Of the emergent habitat types mangroves are likely to be one the most susceptible and slowest recovering habitat types with recovery potentially on a decadal scale if death of trees was to occur. Mangroves could be impacted at the Montebello, Lowendal, Barrow Islands, Dampier Archipelago. These mangroves are identified as KPI values within many of the respective management plans (Table 3-14).

Fish and sharks – Near the sea surface, fish can detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Kennish, 1997; Scholz et al., 1992). As a result, wide-ranging pelagic fish species of the open ocean generally are not highly susceptible to impacts from hydrocarbon spills. This includes the EPBC listed whale shark whose foraging and high density foraging BIA overlap the EMBA (refer Table 3-4), oil pollution is identified as a threat in their respective conservation advice (SPRAT whale shark, great white shark and grey nurse shark, DEE 2017as).

Assessment of the effects on Timor Sea fish following the Montara incident indicated that fish collected initially in Phase I and II of monitoring showed evidence of exposure to petroleum hydrocarbons at sites close to the West Atlas drilling rig, with samples collected one year after (Phase III) suggesting an ongoing trend toward a return to normal biochemistry/ physiology (Gagnon and Rawson, 2011).

Most reef fish are expected to be buffered from contact to floating surface slicks by the overlying water column. Reef fish in the shallowest areas are more susceptible to hydrocarbon spill impacts however, as many reef fish are site attached residents on the reef and are unlikely to move away if their territory is impacted. Impacts due to contact with floating oil may include reduced mobility and capacity for oxygen exchange, behavioural disruption or mortality.

<u>*Marine mammals*</u> – Whales, dolphins and dugongs are smooth skinned, hairless mammals so hydrocarbons tend not to stick to their skin therefore physical impacts from surface oil coating is unlikely. Pinnipeds are more susceptible to physical coating as hydrocarbons tend to adhere to rough surfaces, hair or calluses of animals. Irritation to eyes, ears, airways and/or skin may occur from contact with surface slicks. However, marine diesel have ver low adherence properties and is unlikely to coat skin.

Physical impacts due to ingestion are applicable to surface slicks; however, the susceptibility of cetacean and pinnipeds species varies with feeding habits. Baleen whales are more likely to ingest surface slick hydrocarbon than "gulp feeders" such as toothed whales, and are particularly vulnerable to hydrocarbon ingestion while feeding. Humpback whales, whose migration BIA overlaps the EMBA are more likely to occur in the area during the northern migration period in June/July and southern migration in Sep/Oct so a sea surface plume (>10 g/m^2) of oil might contact humpback whales as they migrate. Similarly, blue whales may encounter a sea surface plume (>10 g/m^2) as they pass through the area during their northern migration in May–August.

Pinnipeds mostly feed on fish and cephalopods, and therefore may ingest surface oil via tainted food source. Marine mammals are at risk of inhaling volatile compounds evaporating from a spill if they surface to breathe in an oil slick (Geraci and St Aubin, 1990).

<u>*Marine reptiles*</u> – Marine turtles and sea snakes when surfacing to breathe may be affected from surface slick hydrocarbons through damage to their airways and eyes. Turtles and sea snakes may be affected by oil through tainted food source or by absorption through the skin. Risk of contact would likely be greatest along intertidal sections of nesting beaches, foraging areas or within shallow waters adjacent to nesting beaches.

The flatback turtle BIAs overlap the EMBA, and the Stag facility overlaps a suggested 60 km inter-nesting buffer BIA from the nesting beaches on Dampier Archipelago (Error! Reference source not found.). However, w hile oil may be impacted as described above, oil spills are not identified as a key threat to the species in the conservation advice (SPRAT) or in the recovery plan (EA 2003).

Seabirds – Seabirds are highly susceptible to hydrocarbon spills and oiled birds may experience hypothermia due to matted feathers and an inability to fly. These impacts are primarily attributed to oiling of birds at the surface from slicks. Oiled birds may experience decreased foraging success due to a decline in prey populations following a spill (Andres 1997, NRC 2003) or due to increased time preening to remove oil from their feathers (Burger 1997). During both winter and migration, shorebirds spend much of their time feeding and depend on nonbreeding habitats to provide the fuel necessary for migratory flight (Withers, 2002).

Oil can reduce invertebrate abundance or alter the intertidal invertebrate community that provides food for nonbreeding shorebirds (Andres 1997, NRC 2003). Reduced abundance of a preferred food may cause shorebirds to move and forage in other—potentially lower- quality—habitats. Prey switching has not been documented in shorebirds following an oil spill. However, shorebirds will feed in alternative habitats when the intertidal zone alone cannot fulfil their energy requirements.

A bird's inability to obtain adequate resources delays its pre-migratory fattening and can delay the departure for its breeding grounds. Birds arriving on their breeding grounds earlier realise higher reproductive success through increased clutch size and offspring survival (for a review, see Harrison et al. 2011). If coastal habitats are sufficiently degraded by oil that pre-migratory fattening is slowed and birds delay departure for their breeding grounds, the individual effects could carry over into the breeding season and into distant breeding habitats (Henkel et al. 2012).

The BIA of several EPBC listed bird species overlap the EMBA (Table 3-3) and may be affected by oil. The wedge tailed shearwater breeding BIA overlaps the Stag drilling operational area and oil pollution is identified as a low threat to the species (SPRAT Wedge-tailed shearwater, DEE 2017as).

Socio-economic – Surface oil may impact upon socio-economic receptors including the oil and gas industry, commercial shipping, fisheries/aquaculture, recreation and tourism, resulting in an economic and social impact. Floating and stranded oil can be highly visible and have a resultant negative effect on tourism.

Impacts on the values associated with Protected Areas may result in loss of fauna/ habitat diversity and/ or abundance, reduction in commercial/recreational/ subsistence fishing, loss of livelihood and loss of income from reduced tourism and commercial productivity. Table 7-8 lists key potential impacts to sensitive receptors present in the EMBA.

Of the AMPs that may be affected, the parks have conservation values associated with biological attributes including migratory seabirds, flatback turtles, humpback whales, freshwater, green and dwarf sawfish, Australian Snubfin, Indo-Pacific Humpback and Indo-Pacific bottlenose dolphins. A surface sheen would not be expected to have any impact on these values.

7.6.2.3 Entrained Exposure

A review of the concentrations of entrained hydrocarbons at which toxic effects have been demonstrated in laboratory studies show wide variation depending on the test organism, duration of exposure, oil type and the initial oil mixture (i.e. nominal loading rates of hydrocarbon versus measured concentrations) (Clark et al., 2001; NOAA, 2001; Gulec and Holdway, 2000; Gulec et al., 1997; Barron et al., 2004). According to a review by IRC (2011) of Group II (MGO) hydrocarbons toxicity to the marine environment, a contact threshold of 500 ppb was found to be highly conservative for a range of species including crustaceans, molluscs, echinoderms and fish.

Potential impacts to marine fauna due to exposure to >500 ppb entrained oil include:

- Harm to internal anatomy if ingested;
- Irritation or damage to sensitive external features such as eyes and skin;
- Damage to feathers of marine birds;
- Damage to respiratory processes of air breathing marine fauna if significant inhalation of volatile fumes occurs at the surface; and
- Toxicological effects to invertebrates, including corals, sponges and ascidians.

Owing to the properties of marine diesel, significant oiling of most hairless/ featherless fauna is unlikely to occur. Marine diesel that reaches shorelines will percolate through sandy beach and cobble profiles, and subsequently biodegrade or continue to evaporate over a short timeframe with small volumes of persistent components taking longer to degrade.

Sensitive shoreline habitats such as mangroves and intertidal reef and seagrass areas may be impacted through exposure to the toxic components of marine diesel, although exposure times will unlikely be significant given the weathering properties of marine diesel. Due to their location on the eastern side of Barrow Island, it is unlikely the small pocket of mangroves will be impacted. Contact to these receptors may have an indirect effect on socio-economic receptors such as fishing and nature-based tourism. Section 7.5.4.3 of this EP describes entrained oil impacts on the marine environment.

Overall Consequence	***Overall Likelihood***	***Residual Ranking***
Minor	Unlikely	Low

7.6.3 Environmental Performance

Environmental Risk		**Unplanned surface release of marine diesel (EUH-04d, e, f)**		
Performance Outcome		**No spill of hydrocarbon to the marine environment**		
ID	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
64	Compliance with MODU refuelling procedure ensures risks of spills during refuelling are reduced	All hoses are fitted with dry-break couplings and are buoyant or fitted with floats	Bunkering checklist completed for each refuelling	MODU OIM Vessel Master
65		Visual inspection of dry break couplings and hoses prior to marine diesel transfer		
66		Permit-to-work documentation is complete and signed off to ensure refueling is undertaken in accordance with the refueling procedure		
67		One person on watch during refueling		
68		Vessels maintain station by DP during refueling procedure		
69		Radio communication maintained during refuelling between MODU and vessel		
70	HSE equipment inspection	Bunding/ drip trays under marine diesel powered equipment and potential leak sources on MODU are inspected prior to drilling activity	Pre-start inspection report	HSE Manager
71	Vessels comply with Stag Marine Facility Berthing Handbook (GF-00-MN-H-00037) *	Support vessels get approval from CPF to come within the 500m restricted zone around Stag CPF	Letter of Contract	Supply Chain Manager (initial Contract) Contract Owner (Contract Execution)
72	Maritime notices	Information provided to Australian Maritime Safety Authority (AMSA), Department of Defence Australian Hydrographic	Notice to Mariners	Drilling Manager

		Service (AHO) and nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities		
73	Lifting operations and maintenance and testing requirements comply with safety requirements	3 monthly inspection of lifting gear and colour tag	Inspection records PMS records confirm maintenance and tests conducted	MODU OIM
74		Annual service/ inspection/ certification of offshore crane		

*1 The Stag Marine Facility Operating Manual (GF-90-MN-G-00038) contains the pertinent information required by the nominated Offtake Tanker in preparation for arriving at anchoring location to prepare for safe arrival, embarkation of Pilot and Surveyor, and transit to the Stag Marine Facility for offtake duties.

7.6.4 ALARP Assessment

Vessel activities are required to support the drilling activity and cannot be eliminated. The use of marine diesel for the Stag drilling activity is necessary as the main fuel supply on vessels and the MODU. Vessel presence is implicit in the drilling activity to transfer supplies/ equipment, offload equipment and waste, perform inspection and maintenance. Therefore, the risk of a marine diesel release cannot be completely eliminated from the Operational Area. The use of marine diesel by support vessels is standard industry practice. Marine diesel is considered a more environmentally friendly fuel than heavier fuel oils which have a greater persistence in the marine environment should a spill occur.

For vessels engaged in drilling activities, the procedures outlined in the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) provide controls to reduce the risk of collision during the drilling activity. Communication is established between the CPF, rig and support vessels before they enter the Operational Area to ensure proposed activities are safe to proceed and to reduce the potential for vessel collision during simultaneous operations.

Controls are in place (refer Section 7.6.3) which reduce the likelihood of spill events. No further controls have been identified that could provide a net benefit in reducing the likelihood or consequence of a marine diesel release to the marine environment and thus the risk and impacts are considered to have been reduced to ALARP.

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage the risk of an unplanned release of marine diesel to the marine environment. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.				
Rejected control	**Hierarchy**	**Practicabl e**	**Cost effective**	**Justification**
N/a	Eliminate	N/a	N/a	The use of marine diesel for fuel for vessels, the MODU and machinery cannot be eliminated, vessels and machinery are required for the operations and marine diesel is therefore required. Other energy sources are not readily available to power all equipment and vessels.
Substitute marine diesel for another hydrocarbon type	Substitute	No	No	The substitute for marine diesel is bunker fuel oil or Stag crude, both of which would have a higher environmental impact than marine diesel. No fuel source has been identified that is more environmentally friendly than marine diesel
N/a	Engineering	N/a	N/a	Machinery is designed for using marine diesel as the fuel oil which reduces the potential impact from an unplanned release to as low as possible. As no other hydrocarbon has been identified that is more environmentally friendly that could still fulfil the equipment requirements, no engineering controls have been identified.
N/a	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline.
N/a	Administrativ e	N/a	N/a	Through the application of specific controls and procedures, and maintenance of machinery, no further administrative controls were identified.

7.6.5 Acceptability Assessment

The potential impacts of an unplanned marine diesel release to the marine environment are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy compliance	Jadestone's HSE Policy objectives are met.
Management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices at the Stag facility, including spill response arrangements.
Social acceptability	Stakeholder consultation has been undertaken (see Section 4), including engagement with the State and National response agencies of DoT and AMSA, commercial and recreational fishing industry bodies and fishers. No concerns have been raised with regards to impacts of a marine diesel spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Laws and standards	Jadestone is obligated to respond to a hydrocarbon spill under the following legislative instruments: ● OPGGS Act Section 572A-F – polluter pays for escape of petroleum) ● AMSA Marine Orders Part 91 ● Protection of the Sea (Prevention of Pollution from Ships) Act 1983 ● Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008
Industry best practice	Response planning and preparedness undertaken in accordance with: ● National Plan for Maritime Environmental Emergencies (AMSA, 2020) ● AMOSPlan (AMOSC, 2017) ● ITOPF (2014) Technical Information Paper 7 (TIP 7) Clean-up of oil from shorelines ● IPIECA (2008) Oil Spill Preparedness and Response Report Series ● IPIECA (2015) A Guide to Shoreline Clean-up Techniques ● IPIECA (2015) Contingency planning for oil spill on water: Good practice guidelines for the development of an effective spill response capability.
Environmental context	The worst-case credible marine diesel spill scenario for the Stag drilling activities is a result of a vessel collision within the Operational Area. The release of oil occurs over five hours and floating oil is not predicted to contact any shorelines. Entrained oil is predicted to reach the waters surrounding the Montebello, Lowendal and Barrow Islands in the worst-case scenario. The sensitive receptors at risk include seabirds, shorebirds, marine fauna and habitats including EPBC listed species, or matters protected under Part 3 and KPIs within respective protected area management plans. Jadestone will have regard to the representative values of the reserves and other information published and endeavour to ensure that priority is given to the social and ecological values, of any AMPs, or state marine parks impacted by a release of marine diesel. The Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species will be applied/ used as guidance in the event of an oil spill.
Conservation and management advice	- Jadestone will have regard to the representative values of the reserves and other conservation advice published and endeavor to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state marine parks impacted by unplanned crude release to ensure that the objectives of the management plans are not contravened . - Noting 'Emergency response' is permitted in all AMPs and state marine parks. - Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorized under the

	OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. - Protected areas within the RISK EMBA predicted to potentially be impacted by crude above threshold levels have been identified as Priority receptors (Section 7.5.5). - The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/used as guidance in the event of an oil spill. - A number of conservation advice, threat abatement plans and management plans identify marine pollution and/or habitat degradation or modification as a threat. The plans require appropriate mitigation measures to be implemented to prevent impacts to the fauna. These plans are listed in Table 3-5 and include: - - Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a) - Recovery plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) - Approved Conservation Advice on *Pristis lavate* (dwarf sawfish) (DEWHA, 2009) - Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015a) - Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (DoE, 2014b) - Approved Conservation Advice for *Pristis zijsron* (green sawfish) (DEWHA, 2008c) - Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a) - Approved Conservation Advice for *Milyeringa veritas* (blind gudgeon) (DEWHA, 2008d) - Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (DEWHA, 2008e) - Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b) - Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) - Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c) - Conservation Management Plan for the Southern Right Whale 2011 – 2021 (DSEWPaC, 2012h) - Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (DSEWPaC, 2011a) - Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled seasnake) (DSEWPaC, 2011b) - Recovery plan for marine turtles in Australia 2017 – 2027 (DoEE, 2017) - Approved Conservation Advice on *Dermochelys coriacea* (DEWHA, 2008f) - Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) - Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015) - Approved Conservation Advice for *Calidris canutus* (Red knot) (TSSC, 2016a) - Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy) (TSSC, 2015i) - Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DoE, 2015c) - Approved Conservation Advice for *Calidris tenuir*ostriss (Great knot) (TSSC, 2016e) - Approved Conservation Advice for *Charadrius lesch*enaultii (Greater sand - Approved Conservation Advice for *Charadrius mo*ngolus (Lesser sand plover) (TSSC, 2016d) - Approved Conservation Advice for *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian) (TSSC, 2016c) - National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC, 2011c) - Approved Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015d) - Approved Conservation Advice for the Abbott's booby *Papasula ab*botti (TSSC, 2020a) - Approved Conservation Advice on *Rostratula au*stralis (Australian painted snipe)

	(DSEWPaC, 2013b) - Approved Conservation Advice on *Sternula nereis nereis* (fairy tern) (TSSC, 2011) Conservation Advice *Thalassarche cauta* Shy Albatross (TSSC, 2020b)
Australian Marine Parks	Australian Marine Parks are established by proclamation under the *EPBC Act* for the purpose of protecting and maintaining biological diversity in the parks. Environment plan (EP) must be consistent with the Australian Marine Park Management plans. There are 7 AMPs within the RISK EMBAs. In all cases where an activity has potential to impact or present risk to AMPs, regardless of whether the activity is inside or outside a park, the EP should evaluate how these impacts and risks will be of an acceptable level and reduced to as low as reasonably practicable (ALARP). Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones. The requirement is that The Director should be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Consultation to notify the Director of Parks when the proposed response activities is completed as part of the Consultation process (Section 4). The Director notification in the event of a spill that would impact one of the AMPs is included in the OPEP and Implementation section of this EP (Section 9). As such this EP is consistent with the Australian Marine Park Management plans.
ALARP	The residual risk has been demonstrated to be ALARP.

8. IMPLEMENTATION STRATEGY

As required under Regulation 14(1) of the OPGGS 2009 (Environment) Regulations, Jadestone must provide an implementation strategy that will ensure:

- All environmental impacts and risks of the activity will be continually identified and reduced to a level that is ALARP;
- Control measures identified in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels;
- That environmental performance outcomes and environmental performance standards are met;
- Arrangements are in place to respond to, and monitor impacts of, oil pollution emergencies; and
- Stakeholder consultation is maintained through the activity as appropriate.

To meet these requirements the implementation strategy outlined in this EP includes the following:

- Details on the systems, practices and procedures to be implemented (Section 8.1);
- Key roles and responsibilities (Section 8.2);
- Training, competencies and ongoing awareness (Section 8.2.3);
- Monitoring, auditing, management of non-conformance and review (Sections 8.3);
- Incident response including Oil Pollution Emergency Plan (Section 8.5 and OPEP);
- Record keeping (Section 8.4.3); and
- Stakeholder consultation (Section 4).

Jadestone is responsible for ensuring that activities within the Operational Area are managed in accordance with the EP, the implementation strategy and the Jadestone Health, Safety and Environment Policy and Business Management System. To ensure Jadestone's environmental management standards and performance outcomes are achieved, all personnel will be required to comply with all relevant requirements of Jadestone's systems and, policies and standards.

8.1 Jadestone Business Management System

Jadestone applies an integrated Business Management System that is aligned with ISO 55000: Asset Management. This covers all activities and includes provision for the systematic management of environment and safety and all other business functions. The Jadestone Business Management System ensures alignment between Company objectives and execution of all exploration and production activities. A schematic outlining the Jadestone Business Management System is provided in Figure 8-1.

The management system sets a structured framework that provides governance across company processes for all organisational activities including drilling, with defined accountabilities and performance requirements for employees and contractors to deliver activities aligned to the vision and requirements of Jadestone Energy.

At the highest level, environmental performance expectations are communicated by the Value Plan for the asset, and by the Jadestone HSE Policy and HSE Plan.

The structure of the management system is organised to describe the business activities by objective functions (Figure 8-2).

Figure 8-1: Business Management System structure

LEAD	Operational Excellence	Value Discipline	People	Stakeholder Management	Risk Management
CORE	Explore	Drill	Develop	Produce	Abandon
HELP	Provide Commercial Guidance	Provide Information	Provide Goods & Services	Provide Customers	Provide Technical Guidance

Figure 8-2 Business activities and objective functions

The objective functions are organised into 'Lead', 'Core' and 'Help', which describe how the intent of the business is delivered. The Lead functions are the activities that provide direction to the Core functions, which represent the life cycle of oil and gas activities. The purpose of the Lead functions is to enact and inform strategy and to guide the Core functions in the delivery of their activities.

Delivery of HSE management and performance is fully integrated (including implementation of the EP) throughout the objective functions relevant to the activity. The relevant functions to the proposed drilling activities are:

- Operational excellence;
- Value discipline;
- People;
- Stakeholder management;
- Risk management;
- Drill;
- Produce; and
- Provide goods and services.

Below is a summary of the mechanisms by which these functional areas contribute to HSE management and environmental performance of activities.

8.1.1 Operational Excellence

'Operational Excellence' provides the systems, tools and processes which ensure that all learning experiences that have the potential to improve safety, integrity and efficiency, and reduce negative impacts to the environment, to be captured, evaluated and disseminated for future implementation.

The Operational Excellence function is a continuous process and is summarised in Figure 8-3.

The Operational Excellence function addresses the key points of:

- Capturing of lessons learnt;

- Review of lessons learnt; and
- Incorporation of knowledge in future work.

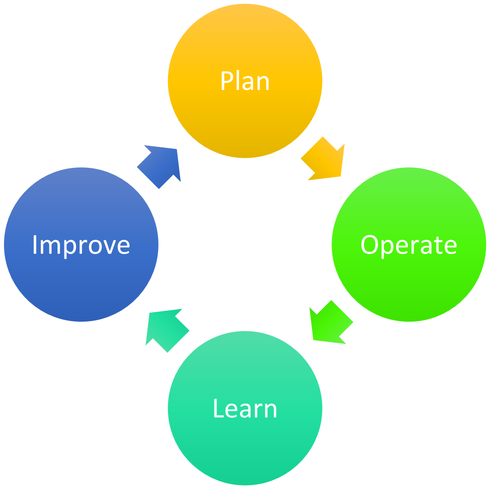

Figure 8-3: Operational excellence business function

Knowledge and best practices can be captured from many sources including internal and external, such as:

- Audits and inspections;
- Emergency response drills;
- Incident reviews;
- Technical papers, legislation and journals; and
- Prior experience.

Processes, procedures and systems are improved based on the historical lessons learnt and applied in subsequent phases. Any actions arising from the assessment of information that are relevant to Jadestone's business management system are incorporated into Bassnet.

8.1.2 Value Discipline

The 'Value discipline' function represents the processes – including annual budgeting, capital funding – that ensure value and capital requirements are met, and support the management system functions delivering their business objectives including HSE performance. Commonly, HSE performance is a proxy for business performance and therefore HSE management is of interest to the Value discipline function of the management system.

8.1.3 People

The Jadestone Energy Competency Assurance Framework provides the formal systems, tools and processes which ensure that personnel are appropriately trained and competent to complete assigned tasks to an expected standard. Competency assurance is a necessary component of any approach to reduce safety, integrity and environmental risks to a level that is ALARP.

The Competency Assurance Framework addresses the key points of:

- Competency requirements (qualification, experience and training) are maintained for all Jadestone Energy positions where the incumbent is required to undertake, supervise, review or verify critical tasks or where the incumbent has the technical authority to approve critical documents;
- Competent persons are members of the workforce who meet the competency requirements for the respective positions to perform critical tasks without direct supervision;
- Candidates being considered for appointment in a critical position are assessed against the applicable competency requirements before being formally appointed;
- Incumbents must be reassessed against the competency requirements as per the required frequency stipulated in the competency matrix; and
- All contractors with personnel in the field are prequalified in accordance with the Contractor Management Framework.

Jadestone Energy personnel are subject to the provisions of the Jadestone Competency Assurance Framework which outlines the training, development and assessment requirements necessary to ensure that all employees have the relevant knowledge and skills required to conduct their activities in a safe and environmentally responsible manner.

A training and skills matrix has been developed for all positions which identifies responsibilities, training and competency requirements. Personnel will complete relevant training and hold qualifications and certificates for their specific role (e.g. well control certificates, rigging and crane operator certificates etc.). Training records will be retained.

8.1.4 Stakeholder Management

Subregulation 11A(3) of the Environment Regulations provides that:

The Implementation strategy of the environment plan must provide for appropriate consultation with:

a) Relevant authorities of the Commonwealth, a State or Territory; and

b) Other relevant interested persons or organisations

Ongoing consultation activities build upon Jadestone's consultation for the EP. Section 4 of the EP Consultation Plan (Appendix E) outlines the processes that will be followed to ensure a standard approach to interacting with relevant persons during the life of the EP, including revision of relevant persons' list and process for dealing with feedback during this period. As part of ongoing consultation Jadestone will undertake the following activities (Table 8-1).

Table 8-1: Standard Consultation Actions

Activity	Frequency and method	Responsibility
Close out of communication commitments made during pre-start consultation including: • Notification to DMIRS of commencement and cessation of activity	• Email DMIRS commencement and cessation notifications at petroleum.environment@dmirs.wa.gov.au	HSE Manager
Review of relevant persons list	• Annually unless triggered earlier	General Manager
Provision of broader information relating to Jadestone environmental policy	• Website updates as required	General Manager

Provide response organisations with a copy of the OPEP	● Email response organisations	ER Lead
Notification of commencement and cessation of activity to NOPSEMA	● Within 4 weeks of commencement date and at cessation	Environment Lead
Notification of AMSA Joint Rescue Coordination Centre (JRCC) of commencement and cessation of activity (rccaus@amsa.gov.au)	● 24-48 hours from commencement of operations	HSE Manager
Notification of commencement of activity to Australian Hydrographic Office (datacentre@hydro.gov.au)	● 4 working weeks prior to operations commencing	Environment Lead
Notification of updates to AHO and JRCC on progress and changes to intended operations	Notification as required	Environment Lead
Notification of updates to Recfishwest on progress and changes to intended operations and commencement and cessation of activity	Notification as required (aaron@recfishwest.org.au)	Environment Lead

In addition, Jadestone will undertake additional triggered consultation as outlined below, should an unplanned event occur (Table 8-2).

Table 8-2: Triggered Consultation Actions

Trigger	Action	Responsibility
Feedback received from relevant person	Follow consultative process outlined in the Consultation for Environmental Approvals procedure.	General Manager
Deviation to the planned activity from those originally provided in consultation	Notification to relevant persons via email (including AHO and JRCC)	General Manager
Change to risk profile in operational area	Notification to government agencies via email to key contact.	General Manager
Change to risk profile in EMBA	Notification to government agencies via email to key contact.	HSE Manager
Significant oil spill event	Notification to response agencies and government agencies immediately by phone. Attempt to electronically notify all relevant persons listed in Table 4-3 as soon as possible. Ongoing updates and communication in accordance with requirements and response procedures. Notification of DPIRD via environment@fish.wa.gov.au within 24 hours of incident report. Notification of TO's and all other stakeholders identified in Table 4-3 within 72 hours of event. Notify AMP Director General within 24-hours of incident report and prior to spill response activities within AMP on 0419 293 465. To include titleholder details, time and location of the incident, proposed response arrangements and locations as per the OPEP. Confirmation of providing access to relevant monitoring and evaluation reports when available and contact details for the response coordinator.	IMT Leader
Biosecurity incident: suspected marine pest or disease	Notification of DPIRD via Aquatic.Biosecurity@dpird.wa.gov.au or 1800 815 507 within 24 hours.	HSE Manager
Change to Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 consultative requirements	Review of Consultation Plan	HSE Manager
Change to Stag's operating jurisdiction such that other legislative instruments stipulate new or additional consultative requirements	Review of Consultation Plan	General Manager
An element of Jadestone's continuous improvement process identifies the procedure needs to be amended	Review of Consultation Plan	General Manager
AMP access	Notify AMP Director General of SMP (or other response activities) within AMP 10 days prior to entering (where possible) and at the cessation of activities in AMPs.	IMT Lead

8.1.5 Risk Management

Jadestone has an integrated approach to risk management to cover all its business activities.

The Risk Management function provides a view of risk that is independent of business and activity objectives and outcomes. This includes strategic, commercial, and control and compliance risks. In addition, it manages health, safety and environment activities, including the preparation and approval of regulatory documents (including this EP) and the management of change process, which addresses all change activities regardless of type – technical, organisational, software or procedural. Further information on the management of change process is provided in Section 8.4.2.

At the activity level, the risk management function considers all the planned aspects and accidental events that may occur. Risk identification and assessment is a continuous process that identifies all the physical control measures necessary to manage impacts and risks. Control measures are subjected to regular assurance activities. In a similar way, audits of the management system are conducted according to review cycle with timing agreed in the annual planning process. Findings from assurance activities, audits and ongoing review of performance are considered in the Operational Excellence process, which considers opportunities for continuous improvement (refer Section 8.1.1).

The Risk Management function is accountable for approval of activity level risk assessments and risk reduction measures; and by so doing, providing a view of risk that is independent from activity outcome measures (e.g. down time, production, success rates, etc.).

8.1.6 Drill

The Drill function plans wells, manages drilling and completions activities for new wells and supports well operations.

The Drill function works closely with the produce function which governs the well acceptance and handover process.

8.1.7 Provide Goods and Services

HSE performance for all activities is achieved either through management of personnel involved, or via management of contracted works.

The Jadestone Competency Management Framework provides personnel with a systematic and uniform approach for managing and improving HSE performance throughout the life cycle of an individual’s appointment, from their selection through to post-completion performance evaluation. The Competency Management Framework addresses the key points of selection, competency, development requirements and management.

HSE performance is also achieved through Jadestone’s Contractor Management Framework. The contract management life-cycle follows four steps: pre-qualification; selection; engagement; and contract completion review process. Through each of these steps Jadestone and service provider/ supplier is evaluated for previous HSE performance and engaged in the mechanisms by which HSE performance will be achieved in the contract to be established.

8.2 Key Roles and Responsibilities

As per Regulations 14(4) and 14(5), a clear chain of command setting out the roles and responsibilities of personnel involved in the activity is required as well as detail on what measures are in place to ensure personnel are aware of their role requirements and how Jadestone evaluates their competency and training needs in these roles. In response to these regulatory requirements, provided in this section is:

- Section 8.2.1 Organisational Chart: outlines the key roles involved in the drilling activities; and summarises the responsibilities of each key role involved in the drilling activities;

- Section 8.2.2 Communication requirements: outlines how personnel fulfilling key roles are made aware of their responsibilities as described in the EP; and
- Section 8.2.3 Assessment of Competency and Training: outlines how Jadestone assesses and evaluates the competencies and training requirements of personnel responsible for achieving the commitments with this EP.

8.2.1 Organisational Structure and Responsibilities

The organisational structure for the drilling activity is presented in Figure 8-4.

Each position has a description outlining their role and responsibilities, accountabilities and reporting lines (Table 8-3). It is the responsibility of all personnel to ensure that the requirements of the Jadestone HSE Policy and commitments within this EP are applied in their area of responsibility and that personnel are suitably trained and competent in their respective roles.

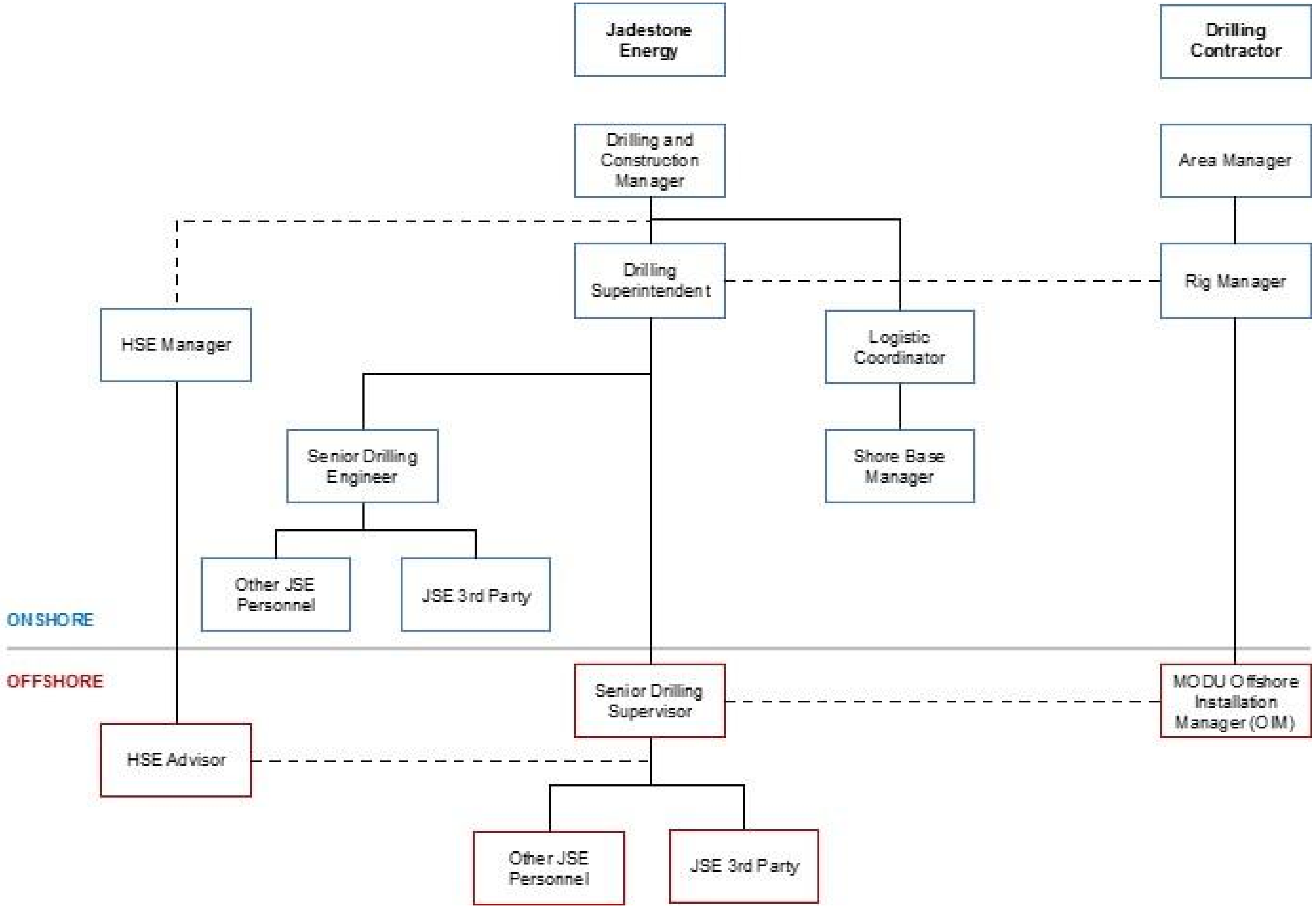

Figure 8-4: Stag Drilling Organisation Chart

Table 8-3: Responsibilities of Key Roles

Role	Key Responsibilities
General Manager	• Ensures that activities are conducted in accordance with the Jadestone's HSE Policy. • Primary responsibility for Jadestone Australia operations and for meeting or exceeding corporate targets for all aspects of performance, including conducting activities in accordance with Jadestone's HSE Policy and this Environment Plan. • Responsible for providing adequate resources for environmental management. • Accountable for Operational Excellence. • Ensures the incident response strategy is implemented in the case of an incident. • Responsible for compliance with the BMS. • Maintains communication with company personnel, government agencies and the media, where appropriate.
Drilling and Completions Manager	• Responsible for ensuring that JSE policies, management principles and standards are followed in the well design and operational phases. • Responsible for ensuring that best practices are used in the planning and execution of wells during the campaign. This includes ensuring that lessons learned in previous campaigns are applied to this current campaign. • Ensure that the requirements of this EP are implemented.
Drilling Superintendent	• The Drilling Superintendent is responsible for offshore well construction operations meeting environmental performance and compliance requirements of the EP. • Coordinate all drilling and associated activities are undertaken by Company personnel and its contractors in accordance with approved programmes and appropriate legislation as detailed in this EP. • Ensure that all operational, technical and environmental incidents during well construction operations are reported to the Drilling and Completions Manager • Responsible for regular reporting through daily reporting formats. • Manage HSE hazards and risks related to drilling maintenance activities by ensuring procedures and risk reduction processes have been employed for all activities under their control.
Logistics Coordinator	• Overall responsibility for implementation of the contractor management framework, including communication of EP requirements to contractors at the appropriate stages of contract management cycle.
HSE Manager	• Ensures review of daily, weekly and monthly reporting, as applicable, from MODU and support vessels. • Ensures environmental department liaison with the Drilling Manager, OIM and Vessel Masters to deliver compliance with all aspects of this EP. • Plans and schedules environmental inspections of the MODU and support vessels. • Ensures regulatory documents are prepared and meet regulatory requirements. • Ensures emergency response plans are in place. • Develops and participates in oil spill response activities. • Ensures reporting of all relevant environmental incidents to NOPSEMA within the required timeframes. • Ensure environmental incident reporting meets regulatory requirements (as outlined in the EP) and internal incident reporting and investigation procedure. • Ensures that proposed changes to environmental management activities are subject to Management of Change and approved prior to application.

Offshore Installation Manager (OIM)	• The OIM is responsible for overall safety of the installation and all the personnel on-board. • The OIM ensures the installation's equipment is fit for purpose and maintained as such. • The OIM must ensure that those he appoints to positions with responsibility for well control are trained, competent, and familiar with those responsibilities and well control equipment. • The OIM will prepare the installation for evacuation in accordance with the level of alert; inform all shore-based parties as required by the emergency response procedures; arrange assistance as the situation may require and delegate someone to maintain a log of events. • The OIM or delegate is the primary interface between Drilling and Completions Manager and the JSE Senior Drilling Supervisor
JSE Senior Drilling Supervisor (SDSV)	• The JSE Senior Drilling Supervisor is responsible for ensuring correct drilling procedures and practices are followed. • Providing daily instructions to well operations, including well control procedures, or other relevant information, and implementing the well control kill method which will be agreed upon with the OIM. • Responsible for HSE and operational support for all phases of rig operations. • Ensures the Program is executed in compliance with JSE policies and is communicated, verbally and in writing, to the appropriate representatives on board the MODU. • Acts as JSE's senior representative and manages all JSE contractors on board the MODU. • Reports directly to the JSE Drilling Superintendent on all matters.
All personnel	• Adhere to work systems and procedures defined for the activities being undertaken. • Follow good housekeeping work practices. • Report HSE incidents, hazards or non-conformances to supervisors in a timely manner. • Identify HSE improvement opportunities wherever possible.

8.2.2 Communication of Responsibilities

The primary mechanism for ensuring personnel involved in the drilling activities are aware of the environmental commitments as listed in this EP are via: provision of environmental performance commitments lists; management of service providers and suppliers and online induction prior to mobilising to the site.

All personnel working at the activity location are required to complete an online induction that contains environmental components prior to arrival. Inductions are updated to account for site-specific factors or activities, or EP management improvements. Induction attendance records for all personnel are maintained. At a minimum, inductions include:

- The Jadestone HSE Policy;
- Description of the environmental sensitivities within the Operational Area and surrounding waters;
- Identification of environmental risks and mitigation measures;
- Permit to work;
- Procedures for reporting of any environmental incidents or hazards;
- Waste management requirements;
- Overview of incident response and spill management procedures, including roles and responsibilities;

- Roles and environmental responsibilities of key personnel; and
- Direction on where to find copies of the EP and OPEP.

8.2.3 Competencies and Training

Jadestone Energy's Contractor Management Framework [JS-90-PR-G-00002] provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability. The assessment of Contractors and Service Providers competency provides a sound level of assurance that all key third-party personnel involved in the activity have the necessary skills, knowledge, experience, and ability to perform their work in accordance with their company's training and competency systems.

Contractors and service personnel are assessed against their company's criteria and any additional criteria required by Jadestone Energy. Records of competent people are maintained in EDMS.

Competencies and training arrangements for personnel involved in oil pollution response are detailed in the OPEP and records maintained in EDMS.

8.3 Monitoring, Auditing, Management of Non-conformance and Review

As required under subregulation 14(6), Jadestone must provide for sufficient monitoring, recording, audits, management of non-conformance and review of Jadestone's environmental performance and implementation strategy to ensure that environmental performance outcomes and standards in the EP are being met and continue to minimise impacts to the environment.

Environmental performance outcomes and standards as well as management controls as detailed in this EP (Sections 6 of the EP and 6 and the OPEP) are monitored and recorded as described. Ongoing monitoring activities to determine if environmental commitments as required in this EP are being met include inspection program, auditing and exercising of response arrangements. Work activities include review of monitoring checklists, audits, inspections, maintenance and continuous improvement reviews, allowing environmental performance of the activity to be monitored. Non-conformances of EP commitments are reported, tracked and closed-out in accordance with Section 8.3.3.

The collection of data from environmental performance monitoring activities forms the basis of demonstration that the commitments as listed are being met, that specified mitigation measures are in place to manage environmental risks, and that they remain working, and contribute to continually reducing risks and impacts to ALARP and acceptable levels.

8.3.1 Routine Monitoring

The purpose of monitoring and inspections is to record performance data and routinely check conformance with environmental performance standards and achievement of environmental performance outcomes defined by the EP. Routine inspection activities are scheduled and records kept in a format and for a period that meets the regulatory requirements.

Emissions and discharges to the environment as a result of the activity are monitored to assess the environmental performance. Table 8-4 details the quantitative records that are maintained for all emissions and discharges during routine or emergencies within the Operational Area as per Regulation 14(7) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

Table 8-4: Summary of routine monitoring of emissions, discharges and waste

Measurement	Frequency	Monitoring Strategy	Record
Volume of drilling discharges	Daily	Volumes used determined from change in inventory	Daily report
Chemicals used and discharged to	Daily	Chemicals used determined	Daily report /

sea		from inventory	inventory list
Oily water	Intermittently – discharge events recorded as they occur	Discharges determined from oil record book (or equivalent)	Oil record book
Garbage (food scraps)	Intermittently – discharge events recorded as they occur	Discharges determined from garbage record book (or equivalent)	Garbage record book
Sewage	Intermittently – discharge events recorded as they occur	Discharges determined from sewage record book (or equivalent)	Sewage record book
Ballast water discharges	Intermittently – discharge events recorded as they occur	Discharges determined from ballast water record log	Ballast water records
Quantity (kms^3) Gas emissions	Continuous	Metering on the MODU Fuel bunkering records	Greenhouse Gas reporting Daily report
Volumes of the following waste types are recorded: • General and putrescible waste • Hazardous waste • Timber/ wood • Recyclables • Cardboard/ paper • Scrap metal • Metal drums & containers • Batteries (lead acid) • Plastic drums and containers	Logged on MODU when transferred via vessel to shore then to licensed waste facility. Vessel also records volumes on manifest	Invoicing process checks vessel manifest against waste disposal records of service provider, and evidence of disposal	Waste records Garbage Record Books
Unplanned discharges of solid objects, hazardous liquids or hydrocarbons	In the event of an incident	Incident only	Incident log

8.3.2 Audits

An audit is a systematic examination and evaluation against defined criteria and performance indicators to determine whether activities/ processes and related results conform to planned arrangements, whether these arrangements are implemented effectively, and if they are suitable to achieve Jadestone's performance outcomes and requirements.

Environmental audits provide assurance that the systems and processes in place to deliver the EP (i.e. the implementation strategy) are suitable and effective. The Jadestone Audit Manual (JS-90-PR-G-00003) describes the planning and conduct of audit activities.

8.3.3 Non-compliances and Corrective Actions

Non-conformances from audits, inspections, regular monitoring or response testing are communicated immediately to the OIM and tracked and monitored by the General Manager until closed.

Opportunities for improvement and corrective actions from reviews, audits, inspections, monitoring and testing activities are documented and tracked to closure.

8.3.4 Reporting

Table 8-5 details the approach to routine environmental performance reporting to the Regulator. Reporting activities relating to reportable and recordable incidents will be as per Regulations 26, 26A, 26AA and 26B.

8.4 Continuous Improvement (Operational Excellence)

8.4.1 Review of Environmental Performance

The review of environmental performance includes an assessment of:

- Review of compliance with environmental performance outcomes and performance standards, and adequacy of measurement criteria;
- Function of environmental management controls relevant to reportable and/or recordable incidents;
- Monitoring data and trends;
- Results of audits and incident investigations;
- Inspection and checklist approaches; and
- Adequacy of monitoring, inspections and audits.

The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures used for future activities, to facilitate continuous improvement in environmental performance.

In the event that new information (audits, inspections, reviews etc.) suggests risks and impacts are no longer reduced to acceptable levels, or controls are no longer effective in reducing the risks and impacts to ALARP and acceptable levels, then the process for identification of further controls through a risk assessment will follow that of the risk assessment methodology for this EP (refer Section 5).

Any opportunities for improvements identified through the risk assessment (i.e. new controls adopted) will be evaluated via a Management of Change process prior to the EP, procedures or processes being modified (Section 8.4.2).

Table 8-5: Summary of reporting requirements

Regulation	Requirement	Required Information	Timing	Type	Recipient
Before the Activity					
Regulation 29(1) & 30 - Notifications	NOPSEMA must be notified that the Activity is to commence.	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form for both notifications.	At least 10 days before the Activity commences	Written	NOPSEMA
During the Activity					
Regulation 16(c), 26 & 26A – Reportable Incident	NOPSEMA must be notified of any reportable incidents For the purposes of Regulation 16(c), a reportable incident is defined as: ● An incident relating to the Activity that has caused, or has the potential to cause, moderate to significant environmental damage ● Types of reportable incidents are described in Table 9-1.	The oral notification must contain: ● All material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out; ● Any action taken to avoid or mitigate an adverse environmental impact due to the reportable incident; and ● The corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	As soon as practicable, and in any case not later than 2 hours after the first occurrence of a reportable incident, <u>or</u> if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident	Verbal	NOPSEMA
		A written record of the verbal notification must be submitted. The written record is not required to include anything that was not included in the verbal notification	As soon as practicable after the verbal notification	Written	NOPSEMA

Regulation	Requirement	Required Information	Timing	Type	Recipient
		A written report must contain: • All material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out; • Any action taken to avoid or mitigate adverse environmental impact due to the reportable incident; • The corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.	Must be submitted as soon as practicable, and in any case not later than 3 days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise.	Written	NOPSEMA
Regulation 26B – Recordable Incidents	NOPSEMA must be notified of a breach of an EPO or EPS, in the environment plan that applies to the Activity that is not a reportable incident	Complete NOPSEMA's Recordable Environmental Incident Monthly Report form via submissions@nopsema.gov.au	The report must be submitted as soon as practicable after the end of the calendar month, and in any case, not later than 15 days after the end of the calendar month. If no recordable environmental incidents have occurred during a particular month, a Nil Incident report must be submitted	Written	NOPSEMA

Regulation	Requirement	Required Information	Timing	Type	Recipient
Regulation 14(2) Regulation 26C Environmental Performance	Regulation 14(2) requires that *"the titleholder report to the Regulator in relation to the titleholder's environmental performance for the activity, and provide that the interval between reports will not be more than one (1) year*". This is known as the Annual Report. Regulation 26(C) requires *"a titleholder undertaking an activity must submit a report to the Regulator in relation to the titleholder's environmental performance for the activity, at intervals provided for in the environment plan."*	Annual reports will contain sufficient information to determine whether or not EPOs and EPSs in the EP have been met. At a minimum, reports shall include: ● An overview of the operations and activities; ● Summary of environmental incidents (recordable and reportable); ● Summary of any Management of Change (MOC), if applicable; ● Summary of audits; ● An assessment of adherence to requirements of the EP, including the EPO and EPS; ● Environmental performance (adequacy of environmental management tools against number of reportable and/or recordable incidents); ● Continued relevance of performance objectives and performance standards; ● Monitoring data and trends; ● Any additional consultation required; ● Lessons learnt. The annual report shall be submitted to satisfy the requirement of Regulation 26 (C).	Jadestone will submit annual performance reports within 3-months of the end of the reporting period once determined.	Written	NOPSEMA
End of Activity					
Regulation 29(2) – Notifications	NOPSEMA must be notified that the Activity is completed	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form for both notifications	Within 10 days after finishing	Written	NOPSEMA

Regulation	Requirement	Required Information	Timing	Type	Recipient
Regulation 14 (2) & 26C – Environmental Performance	NOPSEMA must be notified of the environmental performance of the Activity	Report must contain sufficient information to determine whether or not environmental performance outcomes and standards in the EP have been met	Annual report submitted within 3 months after the anniversary of the reporting period, with the period commencing on the dated Regulation 29 notification form	Written	NOPSEMA
Regulation 25A Plan ends when titleholder notifies completion	NOSPEMA must be notified that the Activity has ended and all EP obligations have been completed	Notification advising NOPSEMA of end of the Activity	Within six months of the final Regulation 29 (2) notification	Written	NOPSEMA

8.4.2 Management of Change and Revisions of the Environment Plan

Regulation 17 of the *Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009* makes clear the following requirements in respect of a number of circumstances that may lead to the deviation of an activity from the EP, or a new activity requiring an EP.

17 Revision because of a change, or proposed change, of circumstances or operations	
New activity	
17(1)	A titleholder may, with the Regulator's approval, submit to the Regulator a proposed revision of an environment plan before the commencement of a new activity.
Significant modification or new stage of an activity	
17(5)	A titleholder must submit to the Regulator a proposed revision of the environment plan for an activity before the commencement of any significant modification or new stage of the activity that is not provided for in the environment plan as currently in force.
New or increased environmental impact or risk	
17(6)	A titleholder must submit a proposed revision of the environment plan for an activity before, or as soon as practicable after:
(a)	The occurrence of any significant new environmental impact or risk, or significant increase in an existing environmental impact or risk, not provided for in the environment plan in force for an activity; or
(b)	The occurrence of a series of new environmental impacts or risks, or a series of increases in existing environmental impacts or risks, which, taken together, amount to the occurrence of:
(i)	A significant new environmental impact or risk; or
(ii)	A significant increase in an existing environmental impact or risk;
	That is not provided for in the environment in force for the activity.

Jadestone's Management of Change process will determine whether a proposed change driven internally by the organisation, triggers the requirements of Regulation 17, which may result in a revision and resubmission of an EP to NOPSEMA. This process is described in the Jadestone's Change Management Procedure (MoC) [JS-90-PR-G-00017]. The procedure describes a system for identifying, tracking, responding, progressing and closing out change requests or queries raised by any party involved in Jadestone Energy activities.

The Change Management Procedure also directs and instructs activity owners on external drivers of change including environmental regulatory and stakeholder requirements, including (but not limited to):

- Changes to legislation;
- Provision of new or now relevant technical/ scientific information;
- Changes in the management arrangements/ plans for protected areas or species; or
- Receipt of new information from relevant persons relating to a proposed or existing activity.

The Change Management Procedure provides for proper consideration of temporary or permanent changes to activities, including an impact and risk assessment, approved and communicated to all appropriate stakeholders together with providing a record of the change. In particular, the system ensures the following:

- All changes required to critical outputs will be identified, recorded, risk assessed and approved – internally and externally as required – before being implemented;
- Processes and procedures are in place to ensure requirements for change are identified and unauthorised changes are prevented;

- All changes must be assessed to determine if the change introduces a new risk or impact or increases an existing impact or risk, as required by Regulation 17;
- The MoC is prepared internally by Jadestone personnel which includes consultation with relevant parties as necessary such as Contractor personnel, technical/ subject matter experts and external stakeholders as required;
- Only authorised and competent members of the workforce can approve changes, including relevant Technical Authorities. Technical Authorities are deemed as authorised and competent via the Technical Authority Framework (GA-60-STD-Q-00001);
- Approval of a change internal to Jadestone requires confirmation that impacts and risks have been assessed and appropriate reduction measures implemented (if required) to manage risk to ALARP and impacts to acceptable levels;
- All approved changes that affect the Environment Plan are properly documented and communicated to all relevant internal and external members of the workforce, e.g. via toolbox talk or HSE meetings and JSA; and
- An audit trail is kept of all changes and documents and drawing are updated accordingly.

MOC must be designed to meet the particular requirements of the type of change required and will include:

- Risk assessment to assess potential impacts to the receiving environment as detailed in this EP, including matters of NES and those areas and/ or species protected under the EPBC Act;
- Strategies and actions to mitigate any adverse effects; identify opportunities offered by the change; and determine how impacted interfaces shall be managed;
- Timeframes for implementation;
- Documents (e.g. drawing, plan, program, procedure) against which change is monitored;
- Outline drawings or controlled documents affected; and
- Responsibilities for execution, review and approval of the:
  - Justification for the change,
  - Assessment of the impact and risk to environment,
  - Detailed implementation requirements,
  - Dissemination of the change, training personnel and updating of documentation.

All alterations and updates to controlled documents, including regulatory approvals, procedures or drawings must be in accordance with Document Control requirements. If the change meets any of the criteria detailed above, a revision/ resubmission of the EP will occur, and the proposed change to the activity will not commence until the revised EP has been accepted by NOPSEMA.

Maintenance work, which covers the replacement of parts or equipment with identical (or equivalent specification) parts or equipment, and with no change to operating arrangements, is not subject to change control.

8.4.3 Record Keeping

This section of the EP meets Regulation 27(2) by detailing a systematic, auditable record of the results of monitoring and auditing of the environmental performance of the drilling activities. The records retained are linked to the performance outcomes, standards and measurement criteria, and monitoring and reporting requirements.

As a minimum, Jadestone will store and maintain the records for five years, where records include:

- Written reports including monitoring, audit and review regarding environmental performance or the business management system;
- Environmental performance reports and associated documentation;
- Documentation generated through stakeholder consultation;
- Records of emissions and discharges;
- Records of calibration and maintenance; and
- Reportable and recordable incident reports.

8.5 Emergency Preparedness and Response

Under the Environment Regulations 14(8) the Implementation Strategy must contain an Oil Pollution Emergency Plan and provide for the updating of the plan containing adequate arrangements for responding to and monitoring oil pollution. These details are contained within the OPEP which is part of this EP and details incident response arrangements in the event of an oil spill and should be referred to for all details.

Emergency response procedures and manuals are in place to describe how controls and consequences are mitigated. These documents are available on the MODU, Stag CPF and drilling and operations vessels and are made accessible to all personnel. The relevant incident response procedures and manuals are detailed in the OPEP.

The Stag Incident Response Plan (GF-00-PR-F-00041), Incident Management Team Response Plan (JS-70-PLN-F-00008) and associated manuals are regularly updated with the revised contact details of relevant organisations and individuals included. They are also frequently tested to determine where they can be improved. The Incident Management Team Response Plan (IMTRP) sets out the structure, organisation and activation, or trigger processes for responding to an incident as well as detailing the schedule for exercising and testing the major hazard incidents and OPEP response and preparedness. The IMTRP also includes as an appendix the Oil Spill Response Arrangements (OSRA). The OSRA sets out the initial actions, notifications and responses once the IMT has triggered an oil spill response.

The Incident Management Exercise & Testing Program (JS-70-PR-F-00001) provides more information on planning and testing cycles. As a minimum, Jadestone conducts quarterly IMT drills, an annual major oil spill exercise, six-monthly oil spill response functional workshops, as well as ad-hoc exercises to coincide with specific project campaigns. The HSE (Emergency Response) Lead maintains an IMT exercise program.

Wherever practical, the IMT exercises, including oil spill responses, may involve support from other agencies, contractors and oil & gas operators as part of resource sharing initiatives. Records of emergency exercises, including OPEP commitments are assessed against measurement criteria and recorded in Jadestone's CMMS BASSnet.

In addition, assurance actions to meet OPEP requirements such as review of Scientific Monitoring capabilities, Waste Contractors compliance and availability of oil spill response vessels and aircraft are scheduled in BASSNet or contractual obligations.

Emergency response, including oil spill arrangements, as part of the implementation strategy are reviewed every 12 months. The scope of the review will be determined by the associated trigger for review. The triggers for the review are:

- document control notification;
- any significant change in the OPEP;

- any change in the risk assessment; and
- significant findings or any requirements from after-action review of drills or incidents.

9. REPORTING

9.1 Routine Reporting

Table 9-1 details the approach to routine environmental performance reporting to the regulator. Reports will be of sufficient detail to demonstrate whether specific environmental performance objectives and standards have been met.

9.2 Incident Reporting

Table 9-1 defines the differences between a reportable and recordable incident. It also defines reporting protocols for initial notification of a reportable incident, written reportable incident reporting and monthly recordable incident reporting. The Incident and Hazard Reporting Procedure (JS-60-PR-F-00016) which incorporates reporting timeframes for incidents depending on their environmental impacts is provided to the MODU and support vessels, and reviewed on an annual basis.

Table 9-1: Routine and incident reporting requirements

Requirements	Timing
Routine Reporting	
Annual Environmental Performance Report The Annual Performance Report for the Drilling Activities will assess compliance with the EP performance objectives, standards and procedures and performance criteria (Table 9-2) and will include: ● An overview of the operations and activities undertaken; ● Summary of environmental incidents; ● Summary of any Management of Change (MOC), if applicable; ● Summary of audits conducted.	Annual Performance report is to be submitted to NOPSEMA within 3 months of end of activity.
Recordable Environmental Incident Monthly Report A written report will be provided to NOPSEMA of any breaches of a performance objective or performance standard identified in the EP, and is not classed as a reportable incident (refer above). The monthly report will include the following: ● Circumstances and material facts concerning the incident; ● Actions taken to avoid or mitigate any adverse environmental impacts; and ● Corrective action taken to prevent recurrence.	Not later than 15 days after the end of each calendar month.
Reportable Incidents: Notifications	
NOPSEMA NOPSEMA will be notified of reportable environmental incidents: i.e. any unplanned event identified as having caused, or having the potential to cause moderate to significant environmental damage. The following is a list of reportable environmental incidents that could occur: ● Uncontrolled release of hazardous chemicals or hydrocarbons more than 80 litres to the marine environment. ● Gaseous releases of more than 300 kg (~255m^3 at Standard Ambient Temperature and Pressure) ● Death or injury to EPBC Act listed marine fauna due to activities in the Operational Area ● Any unforeseen event that has caused or has the potential to cause an impact with moderate or greater environmental consequence as outlined within this EP, which includes: ○ Marine pest introduction (moderate consequence) ○ Unplanned release of stag crude (Major consequence)	Verbal report to NOPSEMA as soon as practicable, but not later than two (2) hours of incident having been identified. As soon as practicable a written record of the verbal notification will be provided to NOPSEMA. Notifications to other regulators are described in Oil Spill Response Arrangements (GF-70-PLN-I-00037).
AMSA Oil pollution incidents in Commonwealth waters must be reported to AMSA.	Within 2 hours of incident having been identified
Department of Water and Environment (DAWE) DAWE will be notified of the following incidents: ● Harm or mortality to Commonwealth EPBC Act Listed Marine Fauna (attributable to the operations activity). ● Spills of hydrocarbons or environmentally hazardous chemicals more	Within 2 hours of incident having been identified

than 80 litres to the marine environment. Any unplanned event identified as having caused, or having the potential to cause moderate to significant impact to a matter of NES.	
Reportable Incidents: Written Reports	
NOPSEMA A written report of a reportable environmental incident will be provided to NOPSEMA and will contain: ● Immediate action taken to prevent further environmental damage and contain the source of the release; ● Arrangements for internal investigation; ● All material facts and circumstances concerning the reportable incident that the operator knows or is able, by reasonable search or enquiry, to find out; ● Immediate cause analysis; and Corrective actions taken or proposed to prevent recurrence of similar incidents with responsible party and completion date.	Written report (Part 1) to NOPSEMA is required within three (3) days. Within 7 days of submitting the written report (Part 1) to NOPSEMA, a copy of the written report will be provided to NOPTA and DMIRS Written report (Part 2) to NOPSEMA is required within 30 days.

Table 9-2: Summary of Environmental Performance for this EP

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
1	Consultation for Environmental Approvals procedure (JS-70-PR-I-00034)	Relevant persons identified according to current Regulatory requirements	Consultation records	General Manager	Relevant persons are kept informed of activities
2		Relevant persons provided a minimum 4-week period to respond to proposed planned activities			
3		If there is a potential change in the risks or impacts to relevant persons due to planned activities relevant persons are to be consulted prior to the activity commencing			
4		Relevant persons provided information 4 weeks prior to commencement of activities to provide a specified timeframe and assets that will be present for the drilling activities including commercial fishing license holders			
5	Vessel and MODU navigation aids and equipment meet regulatory and safety requirements by aligning with Navigation Act 2012	Vessels will comply with maritime safety and navigation requirements including: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS); • Chapter V of Safety of Life at Sea (SOLAS); • Marine Order 21 (Safety of navigational and emergency procedures) (as appropriate to vessel class); • Marine Order 30 (Prevention of collisions) (as appropriate to vessel class) Vessels to maintain radio channels and other communication systems.	PMS confirms navigational equipment is maintained to regulatory and safety standards Records confirm that required navigation equipment is fitted to all vessels to ensure compliance with maritime safety and navigation requirements. Records confirm vessels maintain communication systems.	MODU OIM Vessel Master	Activity lighting managed in accordance with safety requirements

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
6	Vessels will comply with EPBC Regulations 8.05 and 8.06, as per Stag Marine Facility Operating Manual (GF-90-MN-G-00038)	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: - Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and - If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines, or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots. - The above requirements will also apply to whale sharks if they are sighted within 300m of the vessel.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed by Vessel Master. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans) Induction includes whale shark avoidance requirements	Supply Chain Lead Vessel Master Drilling Manager	Controls implemented to ensure no death or injury to EPBC listed marine fauna from noise emissions
7	Helicopters will comply with EPBC Regulations 8.07	Helicopters will comply with the following elements of EPBC Regulations 2000 Regulation 8.07, except during take-off/ landing, during an emergency or when action is required to maintain safe operations: - A helicopter will not operate at a height lower than 1,650 ft or within a horizontal radius of 500 m of a cetacean; and - A helicopter will not deliberately approach a cetacean from head-on. Helicopter operators are required to report any instances where these standards are breached, and any event involving injury to or death of marine fauna due to helicopter operations.	Helicopter Contractor's procedures reflect EPBC regulations 8.07. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans)	Supply Chain Lead	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
8	Safety Case requires MODU machinery is certified and maintained	MODU machinery is maintained in accordance with the MODU PMS.	PMS provides status of maintenance	Drilling Manager	
9	Valid Flag State Certificate indicates vessel machinery and equipment is certified and maintained	Vessel machinery is maintained in accordance with Flag State certification requirements. Maintenance is conducted in accordance with the vessel maintenance management system.	Flag State Certificate / ISM.	Vessel Master	
10	Flag State Certificate (IAPP) certifies measures are in place to manage air emissions	A current International Air Pollution Prevention (IAPP) Certificate that confirms: - Incinerators are certified to meet prescribed emissions standards - Marine diesel engines >130 kW are certified to meet prescribed emission standards - Current waste management plan Measure in place to prevent ODS emissions	Valid and current statutory Certificate (IAPP) Waste Management Plan	Vessel Master	No unplanned emissions to the atmosphere Emissions to air meet regulatory requirements
11	MODU STP operated in line with MARPOL requirements	Current International Sewage Pollution Prevention Certificate for MODU	Valid ISPP Certificate	MODU OIM	No unplanned operational discharges within the Operational Area Operational discharges to sea are in accordance with legislative requirements
12	Maintenance of sewage system: vessels >400 t	Current International Sewage Pollution Prevention Certificate for vessels >400t	Valid ISPP Certificate	Vessel Master	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
13	Oily water filtering and monitoring equipment fitted and maintained	If required under MARPOL Annex I, support vessels have oily water filtering and monitoring equipment that is compliant and surveyed/ maintained as per MARPOL Annex I and an IOPP certificate	Current IOPP	Vessel Master	
14	Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Drilling, completions and cement chemicals used downhole are Gold/ Silver/ D or E rated through OCNS, or have a complete risk assessment, as per Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033).	Completed chemical risk assessment records	Drilling Manager	No unplanned drilling discharges within the Operational Area
15	Cuttings management system	Cuttings returned to the MODU are treated through the onboard cuttings management system to reduce the concentration of drilling mud on cuttings prior to discharge.	Surface losses as reported on the daily mud report	Drilling Manager	
16		The shale shakers have API standard screens for solids removal particle size cut points.	Daily mud report	Drilling Manager	
17		While drilling, the shale shakers are inspected regularly to ensure they are running and are not damaged or blinding	Daily mud report	Drilling Manager	
18	Inventory control work instructions	WBM, brine and drilling water within MODU mud pits that is no longer required will be diverted overboard at the end of the activity.	Daily mud report	Drilling Manager	
19		If dry bulks (such as barite and bentonite) are unused, at the end of the drilling where feasible the stock will be: ● Retained for use on the next well or JSE campaign, this may involve transfer of stock to another MODU or temporary storage; or	Daily mud report	Drilling Manager	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
		• Sold to the next operator of the MODU; or Mixed into a slurry and discharged overboard if the above options are not feasible.			
20		Only unusable inventories of cement will be diverted overboard as a slurry	Daily report	Drilling Manager	
21		Barite selected for use is compliant with API standards which includes contaminant limit concentrations. These include the following limits per kg dry weight in stock barite • Mercury (1 mg/kg) • Cadmium (3 mg/kg) Lead (<2 mg/kg)	Daily report	Drilling Manager	
22		Inventory controls in place ensure that minimal stock is brought on board without compromising the minimum stock required to manage any well control or lost circulation issues.	Daily report	Drilling Manager	

23	Bulk transfer procedures	Bulk solids and liquids transferred in accordance with MODU contractor procedures to reduce the risk of a release to sea. The procedures will include the following requirements: ● Certified hoses are used ● Valve alignment and visual hose checks occur prior to commencing transfers ● Radio communication maintained during transfers between MODU and vessel ● Vessels maintain station by DP during transfer procedure ● MODU control room monitors tank fill levels or air vents watched to detect tank overfill One person on watch during transfers Bulk solids and liquids transferred in accordance with MODU contractor procedures to reduce the risk of a release to sea. The procedures will include the following requirements: ● Certified hoses are used ● Valve alignment and visual hose checks occur prior to commencing transfers ● Radio communication maintained during transfers between MODU and vessel ● Vessels maintain station by DP during transfer procedure ● MODU control room monitors tank fill levels or air vents watched to detect tank overfill One person on watch during transfers	Daily report	MODU OIM	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
24	Seabed Study	A debris survey will be undertaken within the footprint of the proposed final rig position areas to inform final MODU position.	Debris survey report	Drilling Manager	Seabed disturbance limited to planned activities and defined locations
		Study reviewed independently by MODU underwriter to verify no seabed punch through risk	Approved Seabed Study	MODU OIM	
25	Stag Marine Facility Operating Manual (GF-90-MN-G-00038)	AMSA hydrographic charts: Stag Facility is marked on relevant Aus-Charts	Daily vessel report	Vessel Master MODU OIM	Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities
26	Contracts valid and maintained in accordance with Jadestone Energy Contractor Management Framework (JS-90-PR-G-00002) to ensure access to competent personnel and appropriate equipment	Contracts in place and current with competent providers and suppliers	Contractor assessment records	Supply Chain Manager	Spill response has an overall net environmental benefit
		Vessel crew qualified in accordance with International Convention of Standards of Training, Certification and Watch-keeping for Seafarers (STCW95)	Records of crew certificates or third-party inspection document	Supply Chain Lead	
27	AMOSC MSC/AMSA MOU valid for life of the EP	AMOSC membership allowing access to mutual aid arrangements for spill response crew and equipment via a Master Services Contract (MSC) AMSA MOU (access to NRT and resources)	Current AMOSC membership and MSC AMSA MOU valid for 5 years from 2017	Country Manager	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
28	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Assessment of response personnel as being competent and trained according to the requirements of Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Response personnel competency and training records	HR Manager	
		Implement the Incident Management Team Response Plan in the event of a spill of hydrocarbons to the marine environment	Incident log	IMT Lead	
29	Jadestone Energy Audit Manual (JS-90-PR-G-00003) includes emergency response and spill preparedness	Audit of Jadestone's emergency response and spill preparedness requirements as scheduled	Audit schedule Audit reports	ER Lead	
30	OPEP maintained to ensure spill response is appropriate to nature and scale of risk	Spill response planning and preparedness aligned with nature and scale of risk. In the event of a Level 2 or Level 3 spill, compliance with OPEP including develop and implement an IAP using the processes described within the OPEP.	Stag OPEP Response records confirm OPEP was adhered to and an IAP was developed and implemented.	ER Lead	
31	Shipboard Oil Pollution Emergency Plan valid and tested to ensure ability	In line with MARPOL Annex 1, vessels over 400 gross tonnage will have a current Shipboard Oil Pollution Emergency Plan (SOPEP)/ Shipboard Marine Pollution Emergency Plan (SMPEP) and International Oil Pollution Prevention (IOPP) certificate	Current SOPEP and exercise schedule	Operations Manager	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
32	to respond to spills as required by MARPOL	Spill exercises are conducted in accordance with the SOPEP			
33	Personnel aware of roles and responsibilities in the event of a response in accordance with Stag Incident Response Plan (GF-00-PR-F-00041)	Instructs offshore response roles and responsibilities and training requirements.	Training and induction records	Stag OIM	
		Spill exercises conducted as part of incident response drills.	Exercise records	Stag OIM Vessel Masters OIM	
34	Labour hire contract in place for life of EP to source labour for spill response	Labour hire contract in place to provide access to personnel	Labour hire contract	HR Manager	
35	Vessel availability for containment and recovery activity is monitored monthly via Jadestone's nominated	Monitor the availability of vessels that are suitable for deployment of the Containment and Recovery strategy as defined in the OPEP	Monthly monitoring reports	Supply Chain Management	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	vessel broker				
36	Maintain contract with Jadestone's Waste Management Contractor for life of the EP	Waste management contract is maintained which enables access to waste storage facilities and waste transport	Contractor assessment records	Logistics Lead	
37	Maintain contract with scientific monitoring service provider for life of the EP	Scientific monitoring services contract is maintained which enables access to competent personnel to undertake scientific monitoring	Contract valid and current	ER Lead	
38		Scientific monitoring services provider participates in a Jadestone annual exercise for a spill response scenario	Emergency exercise evaluation report	ER Lead	
39	Scientific monitoring plan reviews	12 monthly review of SMPs post OPEP exercise Six monthly external legislative review of environmental matters to ensure currency of information Annual audit of capability and readiness as described in the Scientific Monitoring Implementation Plan and SMP Framework is conducted by Jadestone	Audit Manual (JS-90-PR-G-00003) Notification of membership Contract with external environmental consultancy	ER Lead	
40	Maintain contract with tracker buoy provider for life	Contract is maintained which enables access to tracking buoy services	Contract valid and current	ER Lead	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	of the EP				
41	Vessels and MODU comply with the Biosecurity Manual (JS-70-MN-G-00001)*	All vessels demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance with DAWE ballast water management requirements. Documented evidence of effective management of ship biofouling management, consistent with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).	Marine Superintendent	No introduction of marine pest species
42	Vessels comply with Australian Ballast Water Management Requirements (DAWE 2017)	All vessels discharging ballast water within the Operational Area are to maintain Ballast Water Records as per DAWE (2017) requirements	Ballast Management Plans and Ballast record books	OIM/ Vessel Master	
43	Vessels operate at speeds in accordance with Stag Marine Facility Operating Manual (GF-90-MN-G-00038) to	Vessels operating within the restricted zone must not exceed a speed of five (5) knots.	Vessel Masters provided and required to operate in accordance with the Stag Marine Facility Operating Manual (GF-90-MN-G-00038) – Sign-off sheet for completed	Supply Chain Lead	No death or injury to EPBC Act listed marine fauna due to activities in the Operational Area

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	reduce potential for collision with marine fauna		by Vessel Master.		
44	Competency and Training Management System (JS-60-PR-Q-00015) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	Vessel Master	
45	Marine fauna collisions reported to National Ship Strike Database	Any vessel collision with a whale in the Operational Area is submitted to the National Ship Strike Database at: https://data.marinemammals.gov.au/report/shipstrike Death or injury to EPBC Act listed marine fauna (including cetaceans or whale sharks) from vessel collision are recorded/reported to NOPSEMA and DAWE in line with regulations	Vessel collision incident report Database entry number	HSE Manager	
46	Waste generated during activity will be managed in accordance	Solid waste materials are stored in fit for purpose storage containers and/or lifting skips, labelled and equipped with lids / covers to prevent loss of material during storage and handling.	Garbage Record Book shall be maintained on all facilities in accordance with MARPOL 73/78 Annex V	MODU OIM	No release of non-hazardous or hazardous solid wastes to the marine environment

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	with MARPOL 73/78 Annex V Regulation 9 and the vessel/MODU's Waste Management Plan as required		Regulation 9		
47		Hazardous solid wastes will be managed in accordance with Marine Orders – Part 94 (Marine Pollution Prevention – Packaged Harmful Substances), Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Part III) requirements, and Environmental Protection Regs (Controlled Waste)	A waste register will be maintained to show that hazardous wastes are being collected and returned onshore for disposal	Vessel Master MODU OIM	
48	MODU Marine Operating Manual	Silos are pressure vessels controlled with PSV to prevent over pressuring and rupture of tank/ uncontrolled release of dry bulk solids	PSV register	MODU OIM	
49	MODU/Vessel lifting procedures	All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility	Training records and Competency matrix	Vessel Master MODU OIM	
50	Vessels and MODU are compliant with Marine Order 94 to prevent any packaged harmful substances from entering the marine environment	Safety data sheet (SDS) available for all chemicals to aid in the process of hazard identification and chemical storage and disposal management	SDS available	HSE Manager Marine superintendent Vessel master OIM	Zero unplanned discharges into the marine environment
51		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations	SDS available		
52	Vessels and MODU are compliant with	Chemical management is compliant with Marine Order 93: ● Having a valid International Pollution Prevention	Valid International Pollution Prevention Certificate		

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	Marine Order 93 to prevent any contaminating liquids and chemicals from entering the marine environment	Certificate; ● Reporting marine incidents to AMSA – An incident involving a discharge from a vessel of a mixture containing a liquid substance, carried as cargo or as part of cargo in bulk, must be reported to AMSA via AMSA Form 196 (Harmful Substances Report form) within 24-hours; ● Enacting a compliant Shipboard Marine Pollution Emergency Plan; ● Using a compliant Cargo Record Book; and ● Washing vessel tanks in accordance with the Pollution Prevention Act.	Valid SOPEP/SMPEP Cargo Record Book		
53	Spill kits on the vessel are present in areas of high spill risk	Spill kits are: ● Located near high risk spill areas. Intact, clearly labelled and contain adequate quantities of absorbent materials with waste managed as per vessel Waste Management Plan	Pre-start inspection		
54	MODU move procedure	- Functioning positioning equipment (DGPS) on MODU - Functioning AHTS for final positioning - Preload method as per underwriter and drilling contractor's Marine Operating Manual (MOM) - Position of infrastructure (platform, CALM buoy, pipelines, subsea wellheads) marked into positioning software. - Surveyor on board MODU during MODU move in. - Wells shut in at surface and process depressurised for rig approach and positioning. - Rig move procedures in place (including minimum 2 support vessels for positioning)	MODU move procedure reviewed and approved by JSE, drilling contractor and surveying company. Realtime display and logging	MODU OIM	No spill of hydrocarbon to the marine environment

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
55	Tow equipment	Tow equipment certified as fit for purpose. Tow equipment visually inspected by Rig Mover / Tow Master prior to commencement of tow.	Evidence inspection record	Tow Master	
56	MODU move conducted as per Marine Operating Manual (MOM)	Minimum bollard pull requirements for AHTS met or exceeded. Weather window acceptable for tow and pre-load phase. Tow vessels inspected by Tow Master prior to commencement of tow.	MOM checklist	MODU OIM	
57	Tow Master present during MODU move	Experienced tow master to move the MODU and on board for all transits and positioning.	Master Mariner qualifications and experience	Supply Chain Lead	
58	Emergency shutdown system tested and implemented in the event of a loss of pipeline integrity	Emergency Shutdown (ESD) push buttons located in the central control room and throughout the CPF, tested and fit for purpose every six months	Audit records confirm standard.	Stag OIM	
59		ESDVs are regularly tested and fit for purpose 6 monthly	ESDV Testing records	Stag OIM	
60	Emergency pipeline repair plan in place	Emergency Pipeline Repair Plan (GF-09-PLN-L-00039) is valid and approved prior to commencement of any drilling activity	Controlled document management system records	Stag OIM	
61	Post spill scientific monitoring program	Monitor impacts and recovery of the values and sensitivities identified in this EP in accordance with the OSMP.	Monitoring reports indicate no long-term impacts to the values and sensitivities identified in this EP.	IMT Lead	

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
	undertaken				
62	Lifting Procedures	Lifting operations managed in accordance with MODU work instructions or procedures SIMOPS plan and permit to work procedures in place for any starboard outboard lifts (unplanned during the activity).	PTW and SIMPOS procedures in place prior to lifting	MODU OIM Stag OIM	Lifting Procedures
63	MODU Safety Case	MODU Safety case includes controls for dropped objects including: ● Heavy lift procedures ● Lifting equipment is maintained in accordance with manufacturer specifications, certified and inspected ● All personnel involved in lifts are competently trained ● MODU port forward crane is used for outboard lifts as there is no subsea infrastructure to the east of the MODU	NOPSEMA approved safety case implemented	Drilling Manager	**63**
64	Compliance with MODU refuelling procedure ensures risks of spills during refuelling are reduced	All hoses are fitted with dry-break couplings and are buoyant or fitted with floats	Bunkering checklist completed for each refuelling	MODU OIM Vessel Master	No spill of hydrocarbon to the marine environment
65		Visual inspection of dry break couplings and hoses prior to marine diesel transfer			
66		Permit-to-work documentation is complete and signed off to ensure refueling is undertaken in accordance with the refueling procedure			
67		One person on watch during refueling			
68		Vessels maintain station by DP during refueling procedure			

ID	Management controls	Environmental Performance standards	Measurement criteria	Responsibility	Environmental Performance Objective
69		Radio communication maintained during refuelling between MODU and vessel			
70	HSE equipment inspection	Bunding/ drip trays under marine diesel powered equipment and potential leak sources on MODU are inspected prior to drilling activity	Pre-start inspection report	HSE Manager	
71	Vessels comply with Stag Marine Facility Berthing Handbook (GF-00-MN-H-00037) *	Support vessels get approval from CPF to come within the 500m restricted zone around Stag CPF	Letter of Contract	Supply Chain Manager (initial Contract) Contract Owner (Contract Execution)	
72	Maritime notices	Information provided to Australian Maritime Safety Authority (AMSA), Department of Defence Australian Hydrographic Service (AHO) and nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities	Notice to Mariners	Drilling Manager	
73	Lifting operations and maintenance and testing requirements comply with safety requirements	3 monthly inspection of lifting gear and colour tag	Inspection records	MODU OIM	
74		Annual service/ inspection/ certification of offshore crane	PMS records confirm maintenance and tests conducted		

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APPENDIX A – RELEVANT LEGISLATION

COMMONWEALTH LEGISLATION

Offshore Petroleum and Greenhouse Gas Storage Act 2006

The *OPGGSA 2006* (OPGGSA) entered into force in 2008, superseding and repealing the previous offshore petroleum legislation – the *Offshore Petroleum Act 2006* (OPA) and the *Petroleum (Submerged Lands) Act 1967* (PSLA).

Facilities located entirely in Commonwealth offshore waters are controlled by the Commonwealth OPGGSA and its regulations, including but not limited to the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations).

The Act, and its regulations, is currently administered by the Joint Authority, which consists of the Commonwealth Minister for Resources and Energy and the State Minister for Mines and Petroleum. The WA Minister for Mines and Petroleum acts as a Designated Authority and is advised by the DMIRS whilst the Commonwealth Minister for Energy and Resources is advised by the Commonwealth Department of Industry, Innovation and Science (DIIS).

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations)

Under the OPGGS (E) Regulations an EP is required for proposals under Commonwealth jurisdiction, comprising a description of the environmental effects and risks of the project, and proposed mitigation measures to reduce these risks.

The EP must be submitted to, and accepted by the Designated Authority (DA). The DA for Commonwealth waters adjacent to Western Australian state waters and out to the Australian Exclusive Economic Zone (EEZ) at 200 Nm is NOPSEMA, who administers the regulations.

Environment Protection (Sea Dumping) Act 1981

This Act relates to the waters surrounding Australia's coastlines are protected from wastes and pollution dumped at sea by the *Environment Protection (Sea Dumping) Act 1981* (the Sea Dumping Act). The Sea Dumping Act regulates the loading and dumping of waste at sea. The Act fulfils Australia's international obligations under the London Protocol to prevent marine pollution by dumping of wastes and other matter

Environment Protection and Biodiversity Conservation Act 1999

While the Environment Regulations under the OPGGS Act (see below) manage day to day petroleum activities and apply to any activity that may have an impact on the environment, the EPBC Act (Chapter 4) regulates assessment and approval of proposed actions that are likely to have a significant impact on a matter of National Environmental Significance (NES). Actions that are likely to have a significant impact on a matter of NES require approval by the Commonwealth Environment Minister; the assessment process is administered by the Department of the Environment, Water, Heritage and the Arts. The EPBC Act does not replace the need for an Environment Plan to be approved under the OPGGS (Environment) Regulations before an action can proceed.

Schedule 8 of the EPBC Regulations outlines the Australian IUCN Reserve Management Principles. Jadestone shall have regard to these principles. Matters of “National Environmental Significance” are:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Listed Threatened Species and Communities;
- Listed Migratory Species;
- Nuclear Actions;

- Commonwealth Marine Areas; and
- Great Barrier Reef Marine Park.

Australian Maritime Safety Authority Act 1990

This Act specifies that the Australian Maritime Safety Authority's (AMSA) role includes protection of the marine environment from pollution from ships and other environmental damage caused by shipping. AMSA is responsible for administering the Marine Orders in Commonwealth waters.

This Act specifies that the Australian Maritime Safety Authority's (AMSA) role includes protection of the marine environment from pollution from ships and other environmental damage caused by shipping. AMSA is responsible for administering the Marine Orders in Commonwealth waters.

Biosecurity Amendment (Ballast Water and Other Measures) Bill 2017* and *Quarantine Regulations 2000

The Biosecurity Amendment and Quarantine Regulations are designed to prevent the introduction, establishment, and/or spread within Australia, of human, animal or plant pests and diseases.

Underwater Cultural Heritage Act 2018

This Act replaces the Historic Shipwrecks Act 1976 and extends protection from shipwrecks to other wrecks such as submerged aircraft and human remains. It also increases penalties applicable to damaged sites. The Act came into effect 1 July 2019.

The Act gives clarity to the present and ongoing jurisdictional arrangements for protecting and managing Australia's underwater cultural heritage in line with the 2010 Australian Underwater Cultural Heritage Intergovernmental Agreement.

The Act ensures Australia's underwater cultural inheritance is protected for future generations. It is aligned with the UNESCO 2001 Convention, facilitating Australia to be part of the global community's response to illegal salvaging, looting and trafficking of underwater cultural heritage.

Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007

This Act implements the requirements of MARPOL 73/78 Annex VI for shipping in Commonwealth waters.

National Greenhouse and Energy Reporting Act 2007

This Act establishes the legislative framework for the NGER Scheme which is a national framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by corporations in Australia. Several legislative instruments sit under the NGER Act, providing greater detail about corporations' obligations.

Navigation Act 2012

This Act requires that ships carrying oil and chemical tankers conform to relevant Regulations in Annex I of the MARPOL convention for the Prevention of Pollution from Ships. Marine Orders are a body of delegated legislation made pursuant to the Navigation Act 2012 and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.

Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

This Act regulates the import, export and manufacture of ozone depleting substances such as firefighting equipment and refrigerants.

Protection of the Sea (Harmful Antifouling Systems) Act 2006

This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the use of harmful organotins in ant-fouling paints used on ships.

Protection of the Sea (Prevention of Pollution from Ships) Act 1983

This Act gives effect to the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL 73/78/97 and Annexes). It provides for penalties of up to AUD 10 million for not complying with the MARPOL. Marine Orders are a body of delegated legislation made pursuant to the Navigation Act 2012 and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.

INTERNATIONAL LEGISLATION

Convention on Biological Diversity (1992)

The objectives of the convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

United Nations Framework Convention on Climate Change (1992)

The objective of the convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992 and it came into force on 21 December 1993.

International Convention on Oil Pollution Preparedness, Response and Co-operation (1990)

This convention sets up a system of oil pollution contingency plans and cooperation in fighting oil spills.

Vienna Convention on the Protection of the Ozone Layer (1985) and the Montreal Protocol; on Substances that Deplete the Ozone Layer (1987)

The Convention (ratified by Australia in 1987) and the Protocol (ratified in 1989) concern the phasing out of ozone depleting substances.

United Nations Convention on the Law of the Sea (UNCLOS) (1982)

Part XII of the convention sets up a general legal framework for marine environment protection. The convention imposes obligations on State Parties to prevent, reduce and control marine pollution from the various major pollution sources, including pollution from land, from the atmosphere, from vessels and from dumping (Articles 207 to 212). Subsequent articles provide a regime for the enforcement of national marine pollution laws in the many different situations that can arise. Australia signed the agreement relating to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.

Bilateral Agreements on the Protection of Migratory Birds

Australia has negotiated bilateral agreements with Japan (Japan-Australia Migratory Birds Agreement [JAMBA], 1974), China (China-Australia Migratory Birds Agreement [CAMBA], 1986) and the Republic of Korea (Republic of Korea – Australia Migratory Birds Agreement [ROKAMBA], 2007) to protect species of migratory birds with international ranges.

In November 2006, the East Asian-Australasian Flyway Partnership (Flyway Partnership) was launched in order to recognise and conserve migratory waterbirds in the East Asian – Australasian Flyway for the benefit of people and biodiversity.

Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) (1979)

This Convention was concluded in 1979 and came into force on 1 November 1983. The Convention arose from a recommendation of the United Nations Conference on the Human Environment (Stockholm, 1972), and aims to conserve terrestrial, marine and avian species over the whole of their migratory range. It commits "Range States" to take action to conserve migratory species, especially those under threat. It is an umbrella agreement under which subsidiary regional agreements are established.

International Convention for the Protection of Pollution from Ships (1973) and Protocol (1978)

This Convention and Protocol (together known as MARPOL) build on earlier conventions in the same area. MARPOL is concerned with operational discharges of pollutants from ships. It contains five Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage and garbage. Detailed rules are laid out as to the extent to which (if at all) such substances can be released in different sea areas. The legislation giving effect to MARPOL in Australia is the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, the Navigation Act 2012 and several Parts of Marine Orders made under this legislation.

London (Dumping) Convention (1972)

Dumping at sea is regulated by the convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972 (the 'London Convention'). Article 4 provides a general prohibition on dumping of wastes except as specified in the Convention. The convention has annexed to it two lists of substances, the 'black list' of substances which may not be dumped at all, and the 'grey list' of substances which may only be dumped under a specific permit.

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969)

The convention gives States Parties powers to intervene on ships on the high seas when their coastlines are threatened by an oil spill from that ship.

International Convention on Civil Liability for Oil Pollution Damage (1969)

The convention and the associated International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971 set up a system of compulsory insurance and strict liability up to a certain figure for damages suffered as a result of an oil spill accident.

OTHER APPLICABLE STANDARDS, CODES AND GUIDELINES

Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000

These guidelines include limits for common contaminants and water quality parameters in marine and fresh water.

Australian Ballast Water Management Requirements (DAWE 2020)

These guidelines state the mandatory ballast water requirements and provide information on ballast pump tests, ballast water reporting and ballast water exchange calculations.

National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009)

Guidance document provides generic approach to a biofouling risk assessment and practical information on managing biofouling on hulls and niche areas.

National Occupational Health and Safety Commission (NOHC) Approved Criteria for Classifying Hazardous Substances [NOHSC: 1008 (2004)]

Provides the mandatory criteria for determining whether a substance is hazardous based on its health effects, and optional criteria for determining whether a substance is hazardous based on its ecotoxicological and physicochemical properties.

APPENDIX B – EPBC MATTERS SEARCH REPORTS

- Operational Area
- Operational area with 20km buffer (light and noise)
- EMBA

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

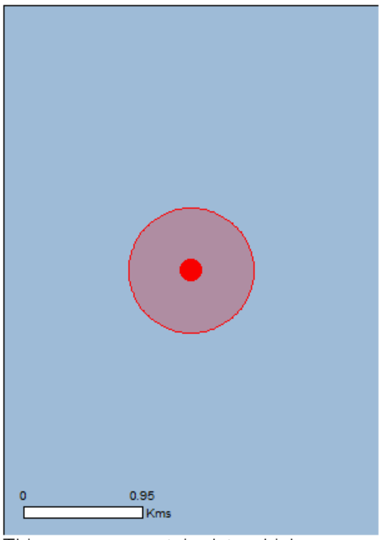
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

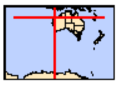
Report created: 14/12/21 15:26:12

Stag 50H and 51H Drilling - Operational Area



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 0.5Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	30

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	62
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.29472 116.28083

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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+61 2 6274 1111

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

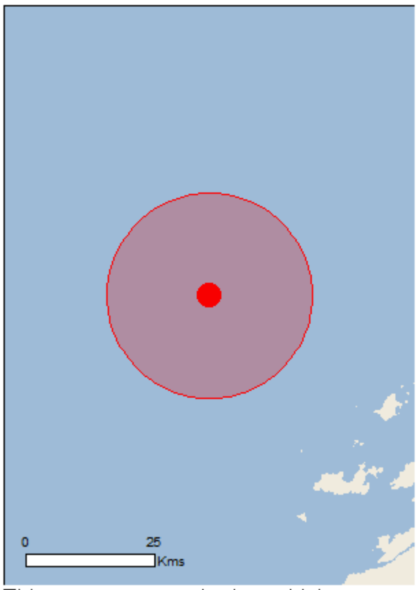
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

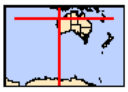
Report created: 14/12/21 15:29:57

Stag 50H and 51H Drilling - 20km buffer around Operational Area



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	20
Listed Migratory Species:	36

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	65
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur

Name	Status	Type of Presence within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Congregation or aggregation known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area

Name	Threatened	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat likely to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Congregation or aggregation known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Congregation or aggregation known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.29472 116.28083

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

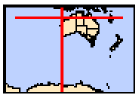
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 14/12/21 15:12:48

Stag 50H and 51H Drilling - Crude Spill EMBA

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	3
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	58
Listed Migratory Species:	91

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	3
Listed Marine Species:	143
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	19

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	31
Regional Forest Agreements:	None
Invasive Species:	23
Nationally Important Wetlands:	5
Key Ecological Features (Marine)	7

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Eighty-mile beach	Within Ramsar site
Roebuck bay	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area

Name	Status	Type of Presence
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		

Name	Status	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Other		
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni		
Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus		
Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - LEARMONTH - AIR WEAPONS RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area

Name	Threatened	Type of Presence
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area

Name	Status	Type of Presence
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Dampier	National Park Zone (IUCN II)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)

Name	Label
Gascoyne	National Park Zone (IUCN II)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Roebuck	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Airlie Island	WA
Barrow Island	WA
Bedout Island	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Cape Range	WA
Jarrkunpungu	WA
Jurabi Coastal Park	WA
Karajarri	WA
Kujungurru Warrarn	WA
Kujungurru Warrarn	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
Murujuga	WA
North Turtle Island	WA
Nyangumarta Warrarn	WA
Serrurier Island	WA
Unnamed WA36907	WA
Unnamed WA36909	WA
Unnamed WA36910	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA44672	WA
Unnamed WA51932	WA
Unnamed WA52366	WA
Yawuru	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Cape Range Subterranean Waterways	WA
Eighty Mile Beach System	WA
Leslie (Port Hedland) Saltfields System	WA
Mermaid Reef	EXT
Roebuck Bay	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-24.6044 111.6334,-22.10533 108.16612,-19.57108 108.11331,-18.18077 109.4333,-15.10095 114.37918,-14.06261 117.54731,-15.9809 120.16982,-17.01924 120.16982,-15.71691 122.31711,-15.80491 122.59872,-16.42087 122.49312,-16.75525 122.0003,-17.75839 121.22587,-17.90414 122.0227,-18.12055 122.12522,-18.16611 122.2733,-18.71281 121.66959,-18.84948 121.44177,-19.4873 120.47355,-19.88594 120.23435,-20.06817 119.58507,-19.95428 119.08388,-20.28458 118.78772,-20.35291 118.13844,-20.54654 117.91063,-20.63765 117.35248,-20.39847 117.06771,-20.43173 116.83994,-20.65003 116.75451,-20.85884 116.31311,-20.6785 116.23718,-20.92053 115.9049,-21.13409 115.5015,-21.42358 115.31642,-21.19104 114.92723,-21.59917 114.72314,-21.80798 114.19157,-21.78425 114.15835,-21.86493 114.00647,-21.98357 113.93528,-22.27306 113.82137,-22.59576 113.66949,-24.6044 111.63346,-24.6044 111.6334

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-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C – STAG CRUDE OIL ASSAY (INTERTEK, 2008)

Sample ID	2063		1	Cut Points					
Crude ID	STAG CPF EXPORT			2	3	4	5	6	7
Client ID	APACHE ENERGY LIMITED								
Date	19 September 2008								
Test	Method	Unit	Whole	LPG	IBP - 230C	230 - 360C	360 - 540C	360C +	540C +
Mass Yield	D2892/D5236	%mass		Nil	4.9	48.2	36.4	47.0	10.8
Volume Yield		%volume		Nil	5.2	49.4	35.4	45.4	10.0
Density @15°C	D5002/D4052	kg/L	0.9428		0.8788	0.9175	0.9670	0.9754	0.9937
Specific Gravity @60/60°F		-	0.9433		0.8793	0.9180	0.9676	0.9760	0.9943
API Gravity		API	18.5		29.4	22.6	14.7	13.5	10.8
Aniline Point	D611	°C			51.9	54.5	62.3	68.8	
Aniline Gravity Product	Calc	-			3685	2940	2119	2103	
Arsenic	ICPMS	mg/kg	2.3						
Ash	D482	%mass	0.0004					0.0070	
Asphaltenes	IP143	%mass	0.14					0.40	
Carbon Residue - Micro	D4530	%mass	1.05					2.48	
Cetane Index - Procedure A	D4737	-				33.2			
Cetane Index - Procedure B	D4737	-				33.0			
Characterisation Factor	UOP375	-	11.3					11.5	
Cloud Point	D2500	°C				<-45.0			
Colour - ASTM	D1500	-				L0.5			
Copper Corrosion (3hrs @ 50C)	D130	-				1A			
FIA - Aromatics	D1319	%volume			18				
Flash Point	D93	°C	111.0						
Freeze Point	D5972	°C			<-70.0				
Heat of Combustion - Gross	D4868	MJ/kg	43.98					43.5	
Heat of Combustion - Net	D4868	MJ/kg	41.48					41.1	
Hydrocarbon - Mono-Aromatics	IP391	%mass				23.4			
Hydrocarbon - Di-Aromatics	IP391	%mass				4.8			
Hydrocarbon - Polycyclic-Aromatic	IP391	%mass				5.0			
Kinematic Viscosity @-20°C	D445	cSt			11.32				
Kinematic Viscosity @20°C	D445	cSt	122.5		3.476				
Kinematic Viscosity @40°C	D445	cSt	37.26		2.282	7.342			
Kinematic Viscosity @50°C	D445	cSt					200.2	675.2	
Kinematic Viscosity @100°C	D445	cSt					14.69	33.54	
Mercury Content	UOP938	wt ppb	<1						
Metal - Nickel	ICP-OES	wt ppm	4.0					7.2	31.4
Metal - Vanadium	ICP-OES	wt ppm	<1.0					<1	<1
Nitrogen - Basic	UOP269	wt ppm	299					158	
Nitrogen - Total	D4629	wt ppm	516				830	1284	3421
PIONA (Benzene)	D6730	%volume			NA				
Pour Point	D5950/D5853	°C	-33			<-39.0	-3.0	0.0	48.0
Reid Vapour Pressure	D323	kPa	<1						
Reid Vapour Pressure	D323	psi	<0.15						
Sediment by Extraction	D4737	%wt	<0.01						
Smoke Point	D1322	mm			16.5				
Sulphur - Mercaptan	D3227	wt ppm							
Sulphur - Total	IP336	%mass	0.14		<0.030	0.057	0.20	0.22	0.31
Total Acid Number	D664	mg KOH/g	0.50			0.08	0.80	0.9	
Water Content	D4006	%volume	0.150						
Wax Content	UOP46	%mass	<5						

APPENDIX D – HYDROCARBON THRESHOLDS

Hydrocarbon thresholds

Hydrocarbon impact pathways and thresholds

The modelling method described is able to track hydrocarbon concentrations of floating oil, entrained oil and dissolved aromatic hydrocarbons below biologically significant impact levels. Consequently, threshold concentrations are specified for the model to control what contact is recorded for surface (floating oil) and subsurface locations (entrained oil and dissolved aromatic hydrocarbons) to ensure that recorded contacts are for biologically meaningful concentrations.

The determination of biologically meaningful impact levels is complex since the degree of impact will depend on the sensitivity of the biota contacted, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The toxicity of a hydrocarbon will change over time, due to weathering processes altering the composition of the hydrocarbon. To ensure conservatism in the environmental impact assessment process, the threshold concentrations applied to the model are selected to adopt the most sensitive receptors that may be exposed, the longest likely exposure times and the more toxic hydrocarbons.

Impact pathways and impact threshold concentrations are detailed below for surface (floating) oil, entrained oil and dissolved aromatic hydrocarbons (DAHs).

Surface (floating) oil

The impact threshold concentration for exposure to surface (floating) oil is derived from levels likely to cause adverse impacts to marine/ coastal fauna and habitats. Marine/ coastal fauna, habitats and socio-economic receptors may be impacted by floating oil in the following way:

- Marine mammals, reptiles and birds can be exposed to oil when at the water surface. For marine mammals and reptiles this can occur when surfacing within a slick to breathe while for birds this includes contact from diving into a slick or floating on the sea surface while feeding or resting. For marine fauna surfacing in floating oil contact to sensitive areas may occur (e.g. eyes, mouth and respiratory system) creating irritation and potentially cell damage. Volatile compounds evaporating form surface oil may be inhaled by marine mammals and reptiles, particularly when the oil is fresh and relatively unweathered. Inhalation of these compounds may cause damage to internal respiratory structures. It is generally considered that marine mammals with smooth skin (e.g. cetaceans) are less susceptible to coating of oil than those covered with hair given hair has a greater potential to trap and retain oil causing longer exposure times. Birds are particularly susceptible to impact from floating oil in that feathers retain oil, particularly when the oil is 'sticky' (e.g. heavy crudes). The coating of oil on birds may hinder flight and feeding, reduce the ability of the bird to thermoregulate (control body temperature) and irritate/damage sensitive surfaces such as eyes, ears and nasal structures. Secondary impacts can occur through the ingestion of oil as birds attempt to preen contaminated feathers. Ingestion may lead to oil absorption and further toxic impacts;
- Surface oil can coat emergent habitats such as coral or rocky reefs and intertidal and shoreline areas around islands or along coastlines. Habitats that can be affected include rocky shorelines, sandy beaches, mangrove communities and intertidal areas which may support seagrass, algae and coral reef communities. The physical coating of mangroves, in particular their root system, can prevent gas exchange and/or cause toxicity at the cellular level. Mangrove response to oil contact includes deforestation, yellowing of leaves and mortality. Other chronic responses include reduced growth, reduced reproductive output and success and genetic mutation. Intertidal areas may be contacted at low tides where emergent habitat is coated by oil. Seagrass, algae and sessile fauna such as hard corals, soft corals and sponges may be smothered as well as small low mobility fauna that live in close association with these and other benthic habitats or within/on sediments. Smothering of intertidal photosynthetic organisms such as seagrass, algae and hard coral may reduce their capacity for photosynthesis (energy production) or lead to a

toxic response at the cellular level. For seagrass and algae this could lead to plant death, shedding of leaves/thalli, reduced growth, reduced reproductive output/success and genetic mutation. Similarly, for hard corals, bleaching, colony death, reduced growth and reduced reproductive capacity may occur. Such impacts may be exacerbated if these organisms are already under stress from marginal environmental conditions or if impacts occur during critical life-history stages (e.g. spawning periods). Small fauna smothered by oil may be hindered in their ability to move and feed or may suffer a toxic response from mortality to reduced growth rate or reproductive success. The coating of habitats can lead to secondary impacts to marine/coastal fauna. For example, marine turtles and shorebirds may be contacted by oil when using nesting beaches or when roosting/feeding along shorelines, respectively. Marine/coastal fauna may also ingest oil when feeding on coated habitats, e.g. dugongs or turtles ingesting coated seagrass/algae and shorebirds ingesting coated intertidal organisms such as molluscs and crabs; and

- Surface oil may impact on socio-economic receptors such as the oil and gas industry, commercial shipping, fisheries/aquaculture and tourism. The presence of floating oil may pose a human health risk from volatile compounds depending on the nature and freshness of the oil (i.e. fresh light oils and condensates posing the greatest risk) while oil spill response activities targeting floating oil may preclude or disrupt activities by other users in the area both offshore and at oil affected shorelines. This could have an economic impact on affected industries. In addition, floating and stranded oil may be highly visible to the general public and have a resultant negative effect on tourism in affected areas. Real or perceived deterioration of nearshore and coastal habitats may also have long lasting effect on the tourism value of an area and of fisheries activities that may rely on those areas to support healthy fish stocks.

There is a paucity of data on floating oil concentrations with respect to impacts to marine organisms. The impact of floating oil on birds is better understood than other receptors. Estimates for the minimum oil thickness that will harm seabirds (through ingestion from preening of contaminated feathers or loss of thermal protection of their feathers) range from at 10 g/m_2 (O'Hara and Morandin, 2010) to 25 g/m^2 (Koops *et al.*, 2004). A conservative threshold of 10 g/m^2 has been applied to impacts from floating diesel and Legendre crude oil. This hydrocarbon threshold is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997) and has also been applied herein to determine impacts of surface oils to emergent habitat such as coral reefs.

A 1g/m^2 threshold was also modelled which may appear as a rainbow sheen and may be indicative of socio-economic impacts.

Entrained oil

Entrained oil is oil that is dispersed within the water column as oil droplets. For oil spills released at surface, entrained oil is created in the top few meters of the water column through mixing of surface oil by wave action. For oil spills released subsea (e.g. pipelines leaks, well blowouts) entrained oil may be distributed deeper within the water column.

The concentrations of entrained droplets output by SIMAP represent hydrocarbons that are not bioavailable. The soluble and semi-soluble fractions dissolve from the droplets over time, and a potential effects analysis based on the dissolved hydrocarbons characterizes their risk.

Because PAHs are the most toxic components of oil and crude oils typically contain about 1% PAHs by mass (French-McCay 2002; Forth et al. 2017), the sublethal concentration threshold (PNEC) expressed as total hydrocarbon concentration (THC, not TPH) based on the most toxic components would be ~100 µg/L (100 ppb) for fresh oil. However, as oil weathers, PAHs are lost to volatilization and degradation. Thus, the whole-oil threshold of 100 ppb is appropriate for fresh oil and conservative (highly protective of aquatic resources) for weathered oil. An exposure concentration of 1,000 ppb (1 ppm or 1 mg/L) of (total) oil hydrocarbons was deemed a low level of concern for sensitive life stages in marine organisms by Kraly et al. (2001). The 1 mg/L concentration is at the low end of the range where sub-lethal impacts from acute exposure have been observed (NRC, 2005). Based on the review of toxicity studies by Bejarano et al. (2017), a THC lethal threshold of 3–28 mg/L (or 3–30 mg/L with rounding, given uncertainties) would be appropriate for a range of oils and states of weathering for species from all geographical areas globally.

Based on this information, a contact threshold of 100 ppb was considered a conservative contact threshold for the assessment of impacts from entrained oil.

Dissolved Aromatic Hydrocarbons

Dissolved hydrocarbons are taken up into organisms directly through external surfaces and gills, as well as through the digestive tract. Thus, soluble and semi-soluble hydrocarbons are bioavailable, whereas insoluble compounds in oil are not bioavailable to aquatic organisms. Laboratory studies have shown that the dissolved hydrocarbons exert the most effects on aquatic biota (Carls et al. 2008; Nordtug et al. 2011; Redman 2015). The volatilization rates of hydrocarbons from surface slicks are faster than the dissolution rates. Thus, dissolution from oil droplets in the water column is the main source of concentrations dissolved in the water.

The most toxic components of oil to water-column and benthic organisms are lower-molecular-weight compounds, which are both volatile and soluble in water (generally in the water accommodated fraction – WAF). The polynuclear aromatic hydrocarbons (PAHs) exert the most toxic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant exposure to occur (Anderson et al., 1974, 1987; Neff and Anderson, 1981; Malins and Hodgins, 1981; McAuliffe, 1987; NRC 2003, 2005). The monoaromatic hydrocarbons (MAHs), including BTEX (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes also contribute to toxicity, but these compounds are highly volatile, so exposures of aquatic biota are minimal or negligible except when light oils are discharged at depth where volatilization does not occur (French-McCay 2002).

French McCay (2018) provides an outline of the measured total PAH concentrations within the water accommodated fraction of medium crude oils as being 74.9 to 282 µ/l.

Within the soluble and semi-soluble hydrocarbons, toxicity is inversely related to solubility, typically quantified by the octanol-water partition coefficient (Kow), a measure of hydrophobicity (Nirmalakhandan and Speece 1988; Hodson et al. 1988; Blum and Speece 1990; McCarty 1986; McCarty et al. 1992a, b; Mackay et al. 1992; McCarty and Mackay 1993; Verhaar et al. 1992, 1999; Swartz et al. 1995; French-McCay 2002; McGrath et al 2009).

Due to the toxic nature of MAHs and low molecular weight PAHs, and the ability for these to be transferred across cellular structures, DAHs contribute to the acute toxicity of an oil. The proportion of BTEX, and other DAHs that are readily dissolved or evaporated, diminish over time. DAH concentration is therefore higher around fresh oil than weathered oil. The toxicity of DAHs to an organism is dependent on both the concentration of the oil and the amount of time an organism is exposed to a given concentration.

The range of LC50s varies from ~10 mg/L (ppb) for 3-ring PAHs (which are semi-soluble) to ~10-100 mg/L (ppm) for the highly soluble BTEX compounds (French-McCay 2002). Thus, the toxicity of an oil hydrocarbon mixture is strongly related to the chemical composition, which varies as the oil weathers since the soluble and semi-soluble hydrocarbons are all volatile to varying degree. Aurand and Coelho (2005) suggest that, based on the wide variation of toxicity data, a threshold of 1,000 ppb will represent a reasonable level for protection of more sensitive life stages of organisms residing in the water column.

For most oil spills, exposures of water column biota to concentrations above potential thresholds of concern are typically on time scales of minutes to hours, even for spills lasting weeks or months because of the varying movements of the oil in the water, dilution and losses to biodegradation and volatilization. Furthermore, the concentrations vary in time over the short exposure periods (McAuliffe et al. 1980, 1981; McAuliffe 1987; Lunel 1994; French McCay 2002, 2004; Bejarano et al. 2014). Thus, the use of LC50s for >48 hours of exposure, or chronic endpoints for longer exposure times, as thresholds for oil spills is highly conservative. Acute aquatic toxicity thresholds would be sufficiently conservative for oil spills in open water systems (as opposed to ponds or other contained systems). There is no need for an ACR correction for evaluating acute toxicity to aquatic biota from oil spills in open waters.

Based on this information, a contact threshold of 50 ppb was considered a conservative contact threshold for the assessment of impacts from dissolved aromatic hydrocarbons.

APPENDIX E – STAKEHOLDER CONSULTATION INFORMATION

1. Introduction

This Appendix outlines some additional detail underpinning the Relevant Person engagement undertaken in support of this EP. This appendix has been redacted prior to publishing to preserve the privacy of those persons or organisations consulted with. This can include the removal of personal information (as defined by the *Privacy Act 1988*) and the removal of any information that was provided during consultation where that person has requested for that information not to be published as per OPGGS(E) Regulations sub-regulation 11(A). Jadestone has made reasonable efforts to inform each relevant person consulted that they may request for particular information not to be published during all stages of the consultation.

The separate sensitive information report containing a log of all communications and copies of communications with relevant persons has not been published due to privacy reasons. Copies of the fact sheets provided during consultation are contained in Attachment 1 to this Appendix.

2. Identification of Relevant Persons

2.1 Value mapping

Regulation 11A (1) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* identifies five groups as relevant persons who must be consulted within the course of preparing an environment plan. The Beneficial Use/Value Mapping process involves listing the potential receptors (with a focus on socio-economic receptors) that may be affected by the proposed activity, and identifying the appropriate area of potential impact (which for this EP is the Operations Area). Then this spatial area is used to determine relevant persons that may have functions, interests or activities in the area. This process was captured in a matrix (Table 10-1). The text below describes the scope of the search that was undertaken. In completing the value mapping process a number of parties (either self-identified or identified by Jadestone) were assessed against the relevant person criteria but were determined not to fulfill the requirements. For completeness these are listed below in Table 10-1.

Marine-based Tourism and Recreation

Aquatic recreation such as boating, diving and fishing occurs near the coast and islands off the Pilbara and Ningaloo coast and to a lesser extent the Rowley Shoals. These activities are concentrated in the vicinity of the population centres such as Exmouth, Dampier and Onslow. Recreational activities and tourism activities are limited due to the remoteness of the location and lack of features in the Operational Area. In the water immediately surrounding the Operational Area, tourism activities are limited due to its distance from the mainland and island shorelines. With the sporadic nature of trips to this locale and the snagging/navigational hazard addressed through engagement with AHO, engagement was conducted through the peak charter association of Western Australia (Marine Tourism WA).

Table 10-1: Beneficial use and value mapping process

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
Aboriginal Heritage	No potential impact pathways identified from routine activities	Operational Area	There are no known sites of Aboriginal Heritage significance within the Operational Area. No identified risks from routine activities.	None identified	None identified	None identified
Native Title	No potential impact pathways identified from routine activities	Operational Area	There are no known registered native title claims in the Operational Area No identified risks from routine activities.	None identified	None identified	None identified
Maritime Archaeological Heritage	No potential impact pathways identified from routine activities	Operational Area	There are no recorded historic shipwrecks or shipwreck protection zones within the Operational Area. No identified risks from routine activities.	None identified	None identified	None identified
Offshore Energy Exploration and Production	Displacement of or Interference of Third-party Vessels	Operational Area	There is no oil and gas infrastructure within the Operational Area.	None identified	None identified	APPEA
Tourism (including diving and marine based activities)	Noise emissions Drilling discharges Accidental/unplanned Discharges Light impacts Displacement of or Interference of Third-party Vessels	Operational Area	Water depths exclude dive activities. Charter fishing may occur but unlikely.	None identified	WAFIC	None identified
Commercial Fisheries (Commonwealth)	Operational discharges Drilling discharges Displacement of or interference with third-party vessels Introduction and	Operational Area	Some fisheries licenced to operate in the area with limited catch data	• Australian Fisheries Management Authority (AFMA) • Department of Agriculture, Water and the Environment	• Australian Southern Bluefin Tuna Industry Association • Australian Fisheries Trade Association	None identified

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
	establishment of Invasive Marine Species*			– Biosecurity and Compliance • Department of Agriculture, Water and the Environment – Fisheries, Forestry and Engagement (Fisheries)	• Commonwealth Fisheries Association (CFA)	
Commercial Fisheries (WA)	Operational discharges Drilling discharges Displacement of or interference with third-party vessels Introduction and establishment of Invasive Marine Species*	Operational Area	Commercial Fishing licence holders have recorded catch and effort in the Operational Area. Some other commercial fishers were included due to permission to operate in the area and historical involvement in Stag consultation.	DPIRD	• Mackerel Managed Fishery (Area 2) (WA) • Onslow Prawn Managed Fishery • Pilbara Trap Managed Fishery • Pilbara Line Managed Fishery • Octopus Development Fishery • Pearl Producers Association • WAFIC	None identified
Commercial Shipping	Displacement of or Interference of Third-party Vessels	Operational Area	Not a major shipping route but vessels may transverse	• Australian Hydrographic Office (AHO) • AMSA	• Managed through AHO who issue notifications to individual companies and users	
Recreational Vessels (including yachts)	Displacement of or Interference of Third-party Vessels	Operational Area	Recreational vessels utilising the activity area safety considerations	• Australian Hydrographic Office (AHO) • AMSA • Dept of Transport	• None identified	

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
Recreational Fishing	Displacement of or Interference of Third-party Vessels	Operational Area	Limited numbers due to remoteness and no shoreline	DPIRD	• Recfishwest • King Bay Game Fishing Club • Nickol Bay Sportsfishing Club	None identified
Marine Parks	No potential impact pathways identified from routine activities	Operational Area	None	Director of National Parks (Parks Australia - Australia Marine Parks)	None identified	None identified
Biological Environment	No potential impact pathways identified from routine activities	Operational Area	Impact on biological values	None identified	None identified	None identified

3. Fisheries Stakeholder Assessment

3.1. Relevant person identification

A separate assessment of relevant fisheries was undertaken to identify which fisheries should be considered relevant parties (Table 10-2). The Operational Area overlapped by the jurisdiction of several Commonwealth and State-managed fisheries.

A summary of each of the fisheries is contained in Section 3.9.1 of the EP. To complete this summary in the EP the Commonwealth and State managed fisheries outlined above were researched further to identify actual fishing effort within the Operational Area over the last five years.

Fisheries were deemed to be relevant persons if they:

- Have jurisdiction to fish within the Operational Area;
- Have recent catch history within the Operational Area (within last 5 years); and
- Fishing methods would mean it was feasible to operate in the water depth or Operational Area.

Jadestone requested catch data from DPIRD for the last 5 years (2016-2020) for the 60 x 60nM reporting grid (20160) and the 10 x 10 nM reporting block (201161) in which the Operational Area sits. Commercial fishing effort in the Operational Area over the last 5 years has been low.

A review of data for fishing tour operators also showed low catch history (very low catch numbers, less than 3 operators). As part of the engagement of relevant persons, DPIRD provided a list of individual fishing tourism operators for the whole of WA. Jadestone reviewed this list and the decision was made to focus on the North Coast (Pilbara/ Kimberley) Fisheries Bioregion where the Stag Facility is located. This list was reduced further to those license holders with addresses between Exmouth and Port Hedland, as it was assumed fishers in closest proximity to Stag would most likely access the area. These stakeholders were deemed relevant and the fisheries consultation package was issued via mail. The individual licence details are found in Table 3 of the Sensitive Information Report.

Table 10-2: Fisheries Relevant Persons Assessment

**Based on an approximate water depth of 49 metres*

Fishery	Jurisdiction	Previously identified as a relevant person in original Drilling EP	Review of relevant person status *Overlapping the activity*	To consult
WA State Managed Fisheries				
Mackerel Managed Fishery (Area 2)	WA	No	Area 2 (Pilbara) fishing area overlaps with Operational Area. Catch history in 10x10nM fishing catch block in last 5 years.	Yes
Pearl Oyster Fishery	WA	Yes	This fishery is primarily a dive and hand collect fishery, which excludes many operators, and there are no ROV fishers active in the area. However, the industry association for this fishery has been contacted for consultation. PPA asked to be kept up to date on any activities through peak body.	Yes
Onslow Prawn Managed Fishery	WA	Yes	Open fishing area overlaps with Operational Area. No effort in 10x10nM block.	Yes
Sea Cucumber Fishery	WA	Yes	Given water depths and hand collection methods for this fishery not considered feasible that this fishery would access the Operational Area. Based on previous advice from WAFIC no need to engage with fishers who may traverse area.	No
Marine Aquarium Managed Fishery	WA	Yes	Given water depths and hand collection methods for this fishery not considered feasible that this fishery would access the Operational Area.	No
Specimen Shell Managed Fishery	WA	Yes	Given water depth, need for ROV to access and long standing exclusion zone not likely to seek to access Operational Area. Confirmed by WAFIC at last engagement (Jan 2019) that no ROV activity in this area now or in the foreseeable future.	No
Pilbara Fish Trawl Interim Managed Fishery	WA	Yes	Operational Area in prohibited fishing area.	No

Pilbara Trap Managed Fishery	WA	Yes	Open fishing area overlaps with Operational Area.	Yes
Pilbara Line Fishery	WA	Yes	Open fishing area overlaps with Operational Area.	Yes
Pilbara Crab Managed Fishery	WA	Yes	Target nearshore waters of Nickol Bay not area that overlaps with Operational Area.	No
Octopus Developmental Fishery	WA	No	New Exemption fishery, 6 Exemptions issued over Onslow Prawn they can only fish out of Onslow Prawn season.	Yes
Sea Urchin Developmental Fishery	WA	No	New Exemption fishery, 4 Exemptions issued. Boundary goes out as far as Marine Aquarium and Specimen, also a dive/wade fishery therefore not relevant to this EP, no consultation required. Given water depths and hand collection methods for this fishery not considered feasible that this fishery would access the Operational Area.	No
West Coast Deep Sea Crustacean	WA	?	Fishery overlaps the Stag site however, no fishing in the north (State of the Fisheries confirms this).	No
Commonwealth-Managed Fisheries				
Western Tuna and Billfish	Comm	Yes	WAFIC advised 1 active fisher as at Jan 2019 WAFIC has confirmed on the record that do not fish inside the 300 metre water depth line.	No
Southern Bluefin Tuna	Comm	Yes	Not actively fishing in this area but overlapped the Operations Area due to the migratory route for this species notification through representative body only not individual licence holders.	Yes via association
Western Skipjack Tuna	Comm	Yes	No Australian boats are currently fishing for skipjack tuna. AFMA has noted as there are no boats fishing in this fishery the management arrangements are under review.	No
Charter/Tourism Operators				
Operators in block 201161	WA	Yes	Catch history over last 5 years in block 201161.	Yes via individual license holders

3.2. Responding to merits of objections or claims

In assessing the consultative feedback a number of considerations need to be made, often depending on the response received. Jadestone implemented the following approach when determining if further follow-up was required regarding correspondence with relevant persons:

No response: Where no response has been received from the relevant person, Jadestone needs to have strong grounds for accepting the relevant person had no response or feedback. The lack of a response can be a function of insufficient time, not understanding the material, not having received the material, etc. Jadestone endeavours to always remind relevant persons of the process at least once prior to deeming it no response. With only a mailing address available for fishers a reminder was not sent to licence holders to reduce stakeholder fatigue. The additional consultation through WAFIC and other representative bodies was considered in determining a no response for this sector.

No issues: Where a relevant person has responded to consultative information and has no concerns or questions regarding the proposed activity, often this allows Jadestone to consider the consultative process for that relevant person and activity to have been satisfactorily closed out and no further follow up for a response required.

Clarification: Where a relevant person sought further information or clarification of information received, this was an opportunity to confirm acceptance of proposed activity and arrangements or if there are any issues that can be identified or may arise.

Objection: Where a relevant person raised an objection regarding the proposed activity, Jadestone representatives sought to understand the issue(s) held by the relevant person and undertake to negotiate arrangements that satisfy both parties. Negotiation processes in the instance an objection was raised were achieved through discussion with the direct parties involved.

For all responses received by Jadestone during the engagement, the merit of each of these responses was assessed. Assessment of merit for all other responses are found in Table 1 of the Sensitive Information Report.

3.3. Record keeping

All activities pertaining to relevant person consultation, including actions and commitments, are recorded and tracked using Jadestone's stakeholder management tool. The live consultation log that is systematically updated as consultation activities are undertaken. Jadestone's stakeholder engagement practice is to keep ongoing records of engagement with stakeholders, as such this practice will be continued post EP submission.

Attachment 1: Fact Sheets

Stag Facility Invitation for Consultation

Invitation for Consultation

Jadestone Energy (Australia) Pty Ltd (Jadestone) is the operator and titleholder of the existing Stag Field Production and Export Facility (Stag Facility). Jadestone is preparing for assessment by the National Offshore Petroleum Regulatory Authority (NOPSEMA) two Environment Plans for the following activities:

- ***Ongoing production and maintenance at the Stag Facility for the next five years; and***
- ***Plugging and abandonment of two production wells and then drilling two new production wells at the Stag Facility.***

We invite you to provide comment for consideration in this process.

Who is Jadestone Energy?

Jadestone Energy (Jadestone) is a leading upstream oil and gas company in the Asia Pacific region, with a focus on production and near-term development assets. The company is listed on the Alternative Investment Market of the London Stock Exchange (JSE). Contact details for the Perth office are provided at the end of this document

What is an Environment Plan?

The purpose of an Environment Plan (EP) is to identify impacts on and risks to the environment related to an activity. The EP also sets measures to reduce environmental impacts and risks and describes how and to what standard those measures will be implemented; this includes emergency situations. There will be two EPs covering:

- Stag operations: covering activities associated with production, oil loading to a third-party tanker, inspection maintenance and repair of the facility, subsea export pipeline, wells and associated subsea infrastructure and non-routine/ unplanned activities and incidents as they arise. This EP is in place and needs to be refreshed after its five-year timeline is now almost due; and,
- Stag drilling: two new production wells to be drilled from the facility, with activities including firstly abandoning two existing wells before drilling the new production wells using a mobile offshore drilling unit or drilling rig.

Length and timing of activities

The Stag Operations EP is being prepared to cover a further five years of operation. The new EP will be consistent with the activities currently undertaken with the facility's operation. Oil is currently produced from the Stag Reservoir by production wells. Seawater is injected into the reservoir to help production and produced water is discharged overboard from the platform. Ongoing drilling and completion activities are necessary to maintain oil production at the facility.

Approximately 90 days is required to plug and abandon two existing wells and then drill two new wells. While timing of the activities will be driven by rig availability, the preferred timing will be between June and October 2022. Activities may occur outside this window and into 2023, and for this reason, it is intended that the drilling EP will remain valid for a two-year period from the time of acceptance.

Location

The Stag Facility is located on the North-west Shelf, approximately 60 km north-west of Dampier. The permit area (WA-15-L) is in Commonwealth waters. The water depth at the Stag Facility is 49 m LAT. Indicative location details are listed here and shown in Figure 1:

- Lat: 20° 16.5" S: Long:116° 15.433" E (GDA 94, Zone 51)

The Stag platform has been present and operating for 20 years, with the required restricted zone in place. This restricted zone of 500 m radius around the platform, catenary anchor leg mooring (CALM) buoy and pipeline will remain in place along with the cautionary area as designated by AMSA of 3 Nm radius charted around the Stag Field facilities.

The Operational Area for the Stag Operations EP is the area within the 500 m radius Restricted Zone that extends around the CPF, subsea export pipeline, and CALM buoy. The Operational Area for the Drilling EP is defined as the area within the 3 Nm radius Restricted Zone that extends around the Stag CPF.

All planned activities will be contained within the Operational Areas.

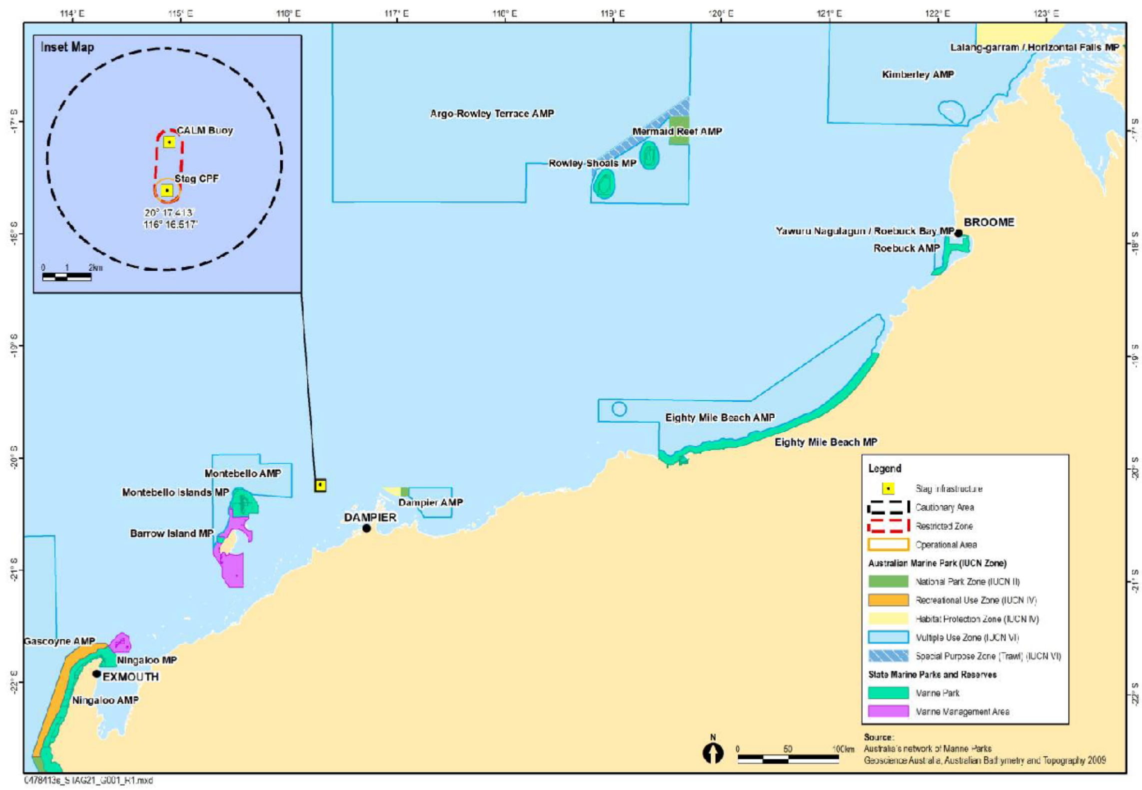

Figure 1 –Stag facility – Location

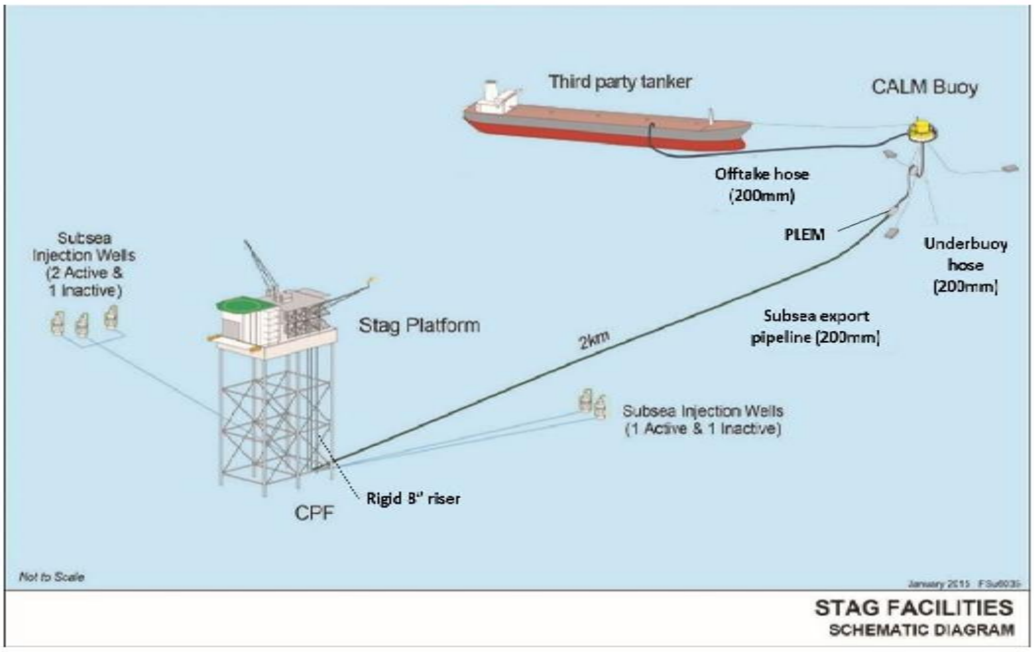

Figure 2 –Stag facility – Existing infrastructure

Operational Area Environmental Values

There are no Matters of National Environmental Significance in the Operational Area.

The distance to Australian Marine Parks (AMP) and other key features in the area is summarised in the table below.

Regional Feature	Distance from Stag CPF
Montebello AMP	30 km
Dampier Archipelago	32 km
Dampier AMP	60 km
Closest Montebello Island	75 km

The benthic habitat in the Operational area is generally sandy seabed with occasional shell or gravel patches that is well represented in the region.

In the event of a hydrocarbon spill the values in a broader Environment that May be Affected (EMBA) have been identified to enable key habitats or locations of particular value in the region to be responded to as protection priorities.

Potential risks and management

A summary of potential risks to the fishery sector that are common to both Environmental Plan activities is provided below. For each risk the associated management measures are summarised in Table 1.

TABLE 1: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES COMMON TO BOTH ENVIRONMENT PLANS

Potential Risks	Mitigation and /or Management Measures
Light Emissions	• Potential impacts from lighting are assessed as occurring within 20 km of a vessel or facility based on the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019) • Facility and vessel navigation lights are compliant with the Navigation Act 2012
Noise Emissions	• Vessels and helicopters comply with relevant parts of EPBC Regulation (2000) Part 8 • Vessel and machinery are maintained in accordance with Flag State certification requirements • All engines, compressors and machinery on the CPF and MODU are maintained via a maintenance management system
Atmospheric Emissions	• Flag State Certificate and/or IAPP certifies measures are in place to manage air emissions • All engines, compressors and machinery on the CPF and MODU are maintained via a maintenance management system
Operational discharges	• Emissions and discharges of liquid waste to sea are in accordance with legislative requirements, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna • Waste Management Plan
Interaction with other users	• A pre-existing 500 m restricted zone is in place around the facility and will remain in place for the duration of operations under the proposed EPs, including during the drilling activity as the MODU will be within the 500m restricted zone of the CPF. No fishing vessels are to enter this zone • Commercial fishers are permitted to enter the wider 3Nm cautionary zone and fish, transit or anchor for the duration of operations under the proposed EPs, as long as it is safe to do so • Notice to Mariners and charts will show zones
Interaction with fauna	• Vessels operating within the restricted zone must not exceed a speed of five (5) knots • Induction includes information on speed limits and requirements for interacting with marine fauna
Physical Presence	• Seabed disturbance limited to planned activities and defined locations

In addition to the risks outlined in Table 1, the risk of produced water discharge is specific to the Stag Operations EP activities (Table 2).

TABLE 2: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES ASSOCIATED ONLY WITH STAG 5 YEAR OPERATIONS EP

Potential Risks	Mitigation and /or Management Measures
Produced water discharges	• Beyond temporary perturbation to water quality, no environmental impacts due to the discharge of produced water are expected • Produced water discharges are monitored and recorded with adaptive management processes in place if significant changes are identified

In addition to the risks outlined in Table 1, the risk of drilling discharges is specific to the Stag Drilling EP activities (Table 3).

TABLE 3: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES ASSOCIATED ONLY WITH STAG DRILLING EP

Potential Risks	Mitigation and /or Management Measures
Drilling discharges	• Selection process for materials as part of NOPSEMA approval • Process for inventory control to minimise leftovers • Cuttings management system in place to manage muds (no synthetic based muds planned for use)

Additional risks that are associated with events that are not expected to occur during normal activities are outlined in Table 4.

Potential Risks	Mitigation and /or Management Measures
Introduced Marine Species (IMS)	• IMS Management will meet legal requirements and reduce risks to ALARP and acceptable levels • Vessels will be required to adhere to ballast water management, quarantine and biofouling requirements if required
Unplanned discharges	• No release of non-hazardous / hazardous solid wastes or non-hydrocarbon hazardous liquids to the marine environment • Dropped object prevention • Waste management plan implemented, and details included in induction materials • Spill kits available and incident response plans in place
Vessel/MODU collision	• Marine notifications will be made to relevant stakeholders, describing the location of the activity and a 500 m petroleum safety zone is present to prevent the risk of collisions • Vessels operating within the restricted zone must not exceed a speed of five (5) knots • Simultaneous Operations (SIMOPS) plan in place to interface between the Stag facility and MODU during drilling • Navigation lights installed and checked
Hydrocarbon release	• Oil Pollution Emergency Plan • Procedures in place on CPF to prevent hydrocarbon release to sea during operations • Procedures in place on MODU to prevent hydrocarbon release to sea during drilling • Appropriate vessel spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment

Providing Feedback

If you would like to comment on the proposed activity outlined in this fact sheet or would like additional information, please contact Jadestone before Monday 20th December 2021.

Feedback can be provided at any time before/during or after the activity.

Phone: 08 9486 6600 Email: consult@jadestone-energy.com

Our Perth office is located at: The Atrium, Level 2, 168 St Georges Terrace, Perth WA 6000

Any person providing feedback is asked to advise if this information is to remain confidential and they do not wish it to be published within the Environment Plan.

Stag Facility
Invitation for Consultation

Fishing sector

Invitation for Consultation

Jadestone Energy (Australia) Pty Ltd (Jadestone) is the operator and titleholder of the existing Stag Field Production and Export Facility (Stag Facility). Jadestone is preparing for assessment by the National Offshore Petroleum Regulatory Authority (NOPSEMA) two Environment Plans for the following activities:

- ***Ongoing production and maintenance at the Stag Facility for the next five years; and***
- ***Plugging and abandonment of two production wells and then drilling two new production wells at the Stag Facility.***

We invite you to provide comment for consideration in this process.

Who is Jadestone Energy?

Jadestone Energy (Jadestone) is a leading upstream oil and gas company in the Asia Pacific region, with a focus on production and near-term development assets. The company is listed on the Alternative Investment Market of the London Stock Exchange (JSE). Contact details for the Perth office are provided at the end of this document.

What is an Environment Plan?

The purpose of an Environment Plan (EP) is to identify impacts on and risks to the environment related to an activity. The EP also sets measures to reduce environmental impacts and risks and describe how and to what standard those measures will be implemented; this includes emergency situations. There will be two EPs covering:

- Stag operations: covering activities associated with production, oil loading to a third-party tanker, inspection maintenance and repair of the facility, subsea export pipeline, wells and associated subsea infrastructure and non-routine/ unplanned activities and incidents as they arise. This EP is in place and needs to be refreshed after its five-year timeline is now coming due.
- Stag drilling: two new production wells to be drilled from the facility, including firstly abandoning two existing wells before drilling the new production wells using a mobile offshore drilling unit or drilling rig.

Length and timing of activities

The Stag Operations EP is being prepared to cover a further five years of operation. The new EP will be consistent with the activities currently undertaken with the facility's operation.

Oil is currently produced from the Stag Reservoir by production wells. Seawater is injected into the reservoir to help production and produced water is discharged overboard from the platform. Ongoing drilling and completions activities are necessary to maintain oil production at the facility.

Approximately 90 days is required to plug and abandon two existing wells and then drill two new wells. While timing of the activities will be driven by rig availability, the preferred timing will be between June and October 2022. Activities may occur outside this window and into 2023, and for this reason, it is intended that the drilling EP will remain valid for a two-year period from the time of acceptance.

Location

The Stag Facility is located on the North-west Shelf, approximately 60 km north-west of Dampier. The permit area (WA-15-L) is in Commonwealth waters. The water depth at the Stag Facility is 49 m LAT. Indicative location details are listed here and shown in Figure 1:

- Lat: 20° 16.5” S: Long:116° 15.433” E (GDA 94, Zone 51)

The Stag platform has been present and operating for 20 years, with the required restricted zone in place. This restricted zone of 500 m radius around the platform, catenary anchor leg mooring (CALM) buoy and pipeline will remain in place along with the cautionary area as designated by AMSA of 3 Nm radius charted around the Stag Field facilities.

The Operational Area for the Stag Operations EP is the area within the 500 m radius Restricted Zone that extends around the CPF, subsea export pipeline, and CALM buoy. The Operational Area for the Drilling EP is defined as the area within the 3 Nm radius Restricted Zone that extends around the Stag CPF.

All planned activities will be contained within the Operational Areas.

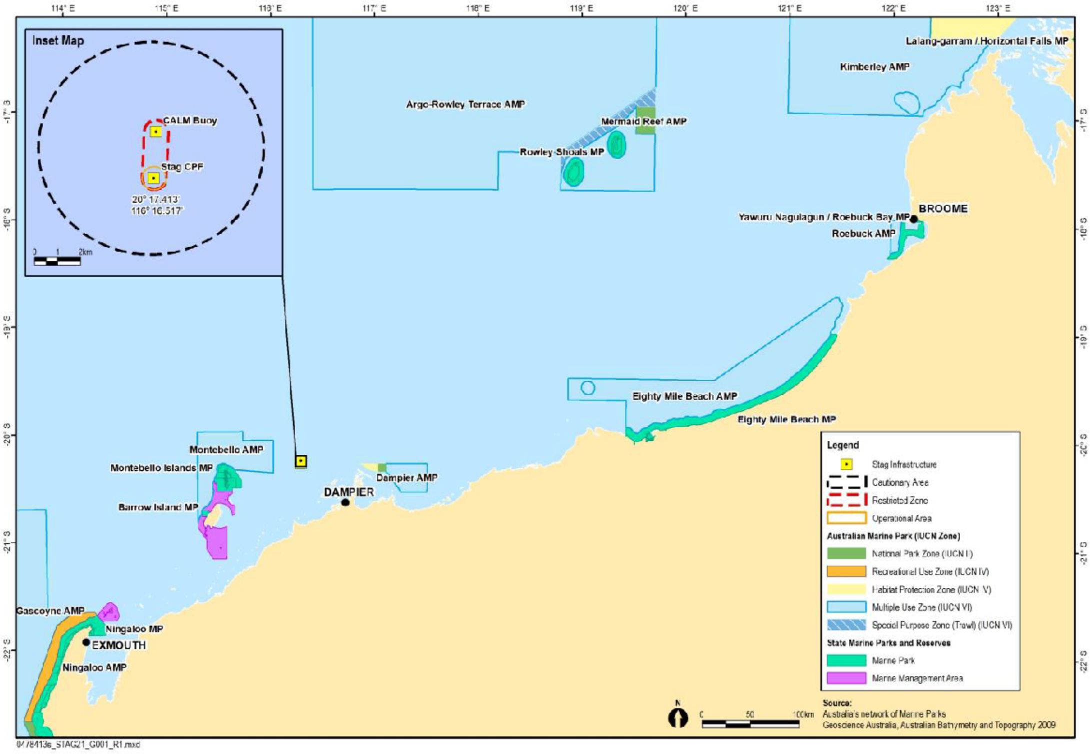

Figure 1 –Stag facility – Location

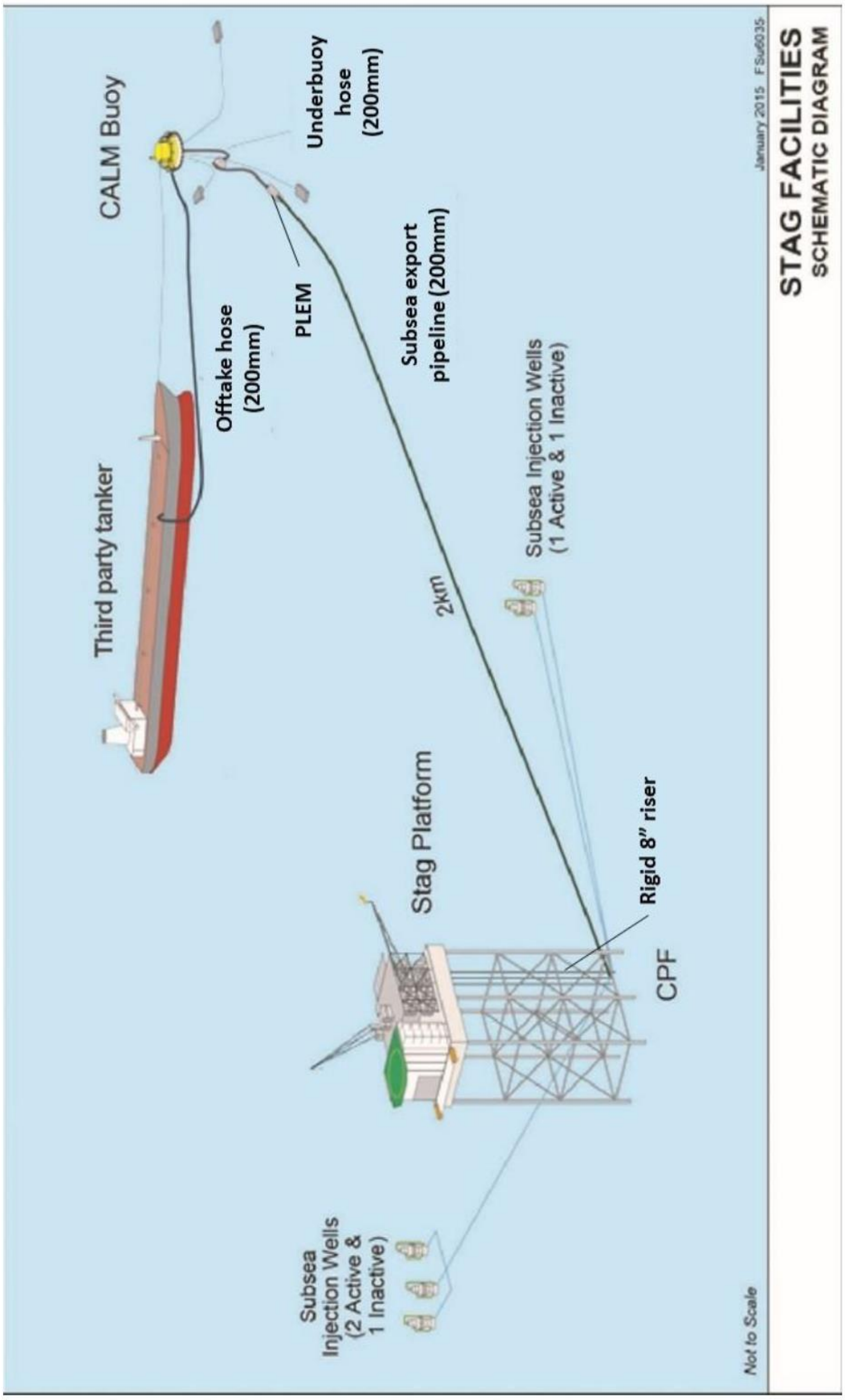

Figure 2 –Stag facility – Existing infrastructure

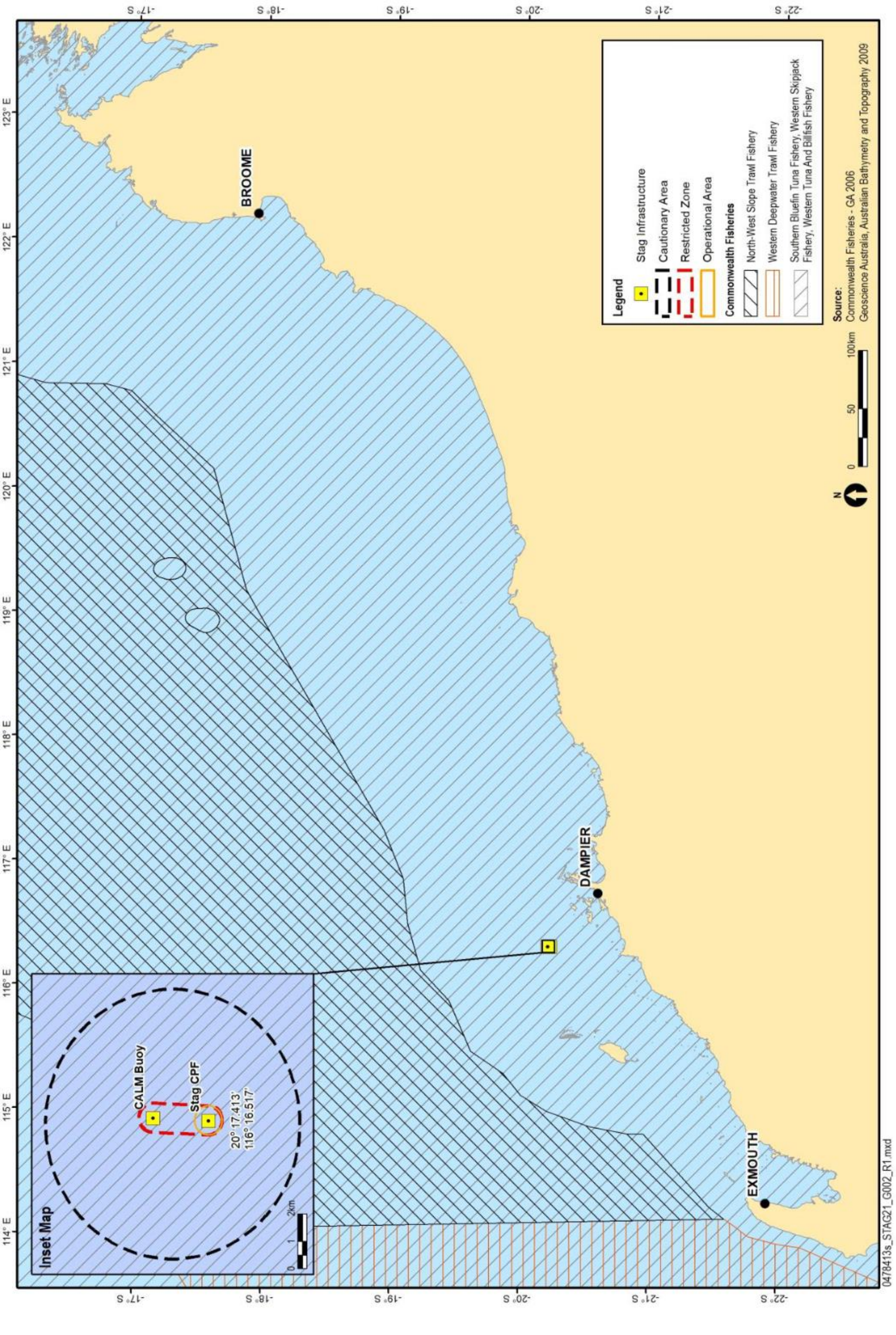

Figure 3 – Commonwealth Commercial Fishing Zones in the vicinity of the Stag Facility

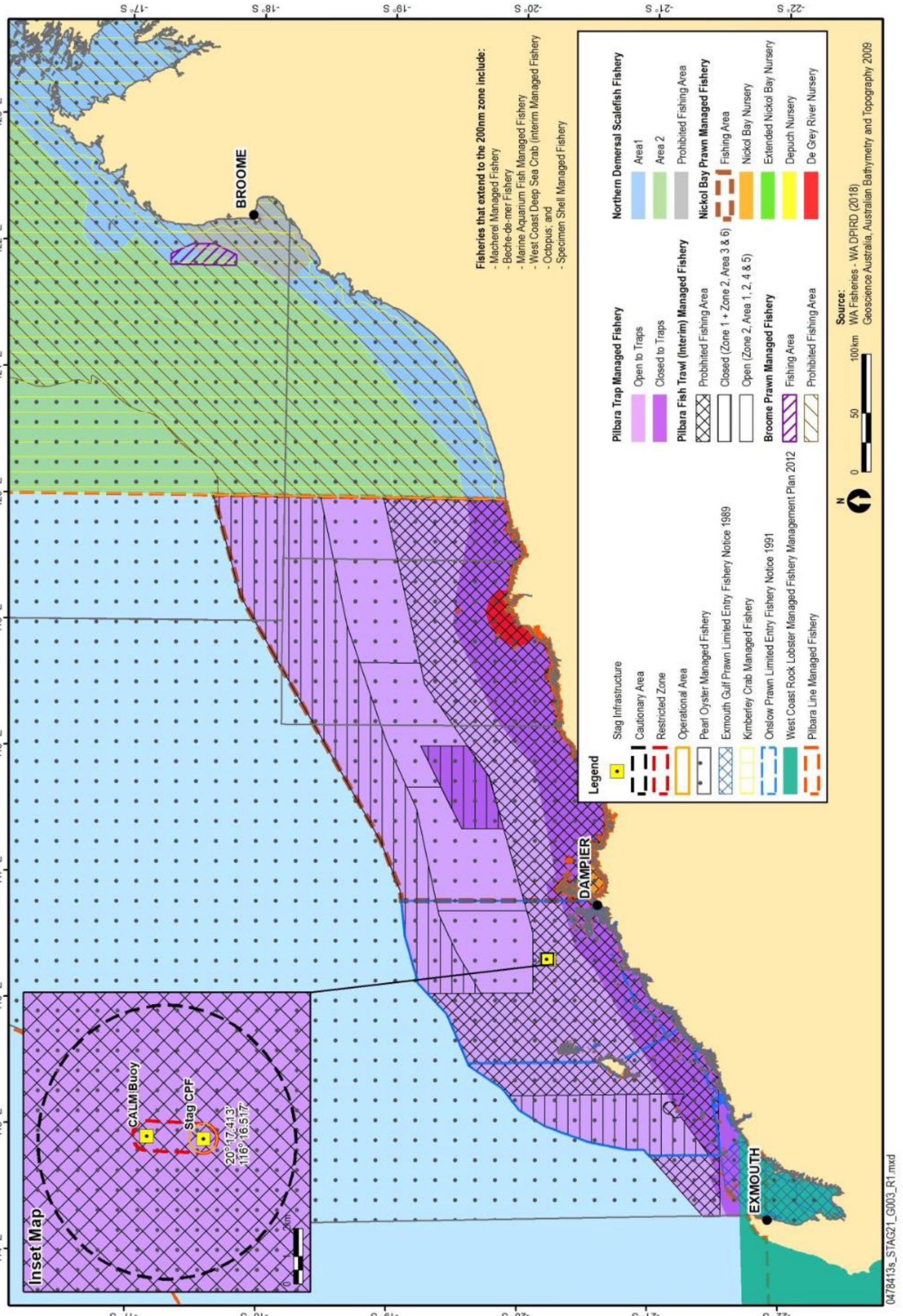

Figure 4 – State Commercial Fishing Zones in the vicinity of the Stag Facility

What fisheries may be affected?

As Figures 3 and 4 indicate, there are a number of fisheries permitted to operate in the operations area. Fisheries that are licensed to operate and were assessed as having potential to utilise this area in the future (based on catch history over the last 5 years) include:

- **Mackerel Managed Fishery - Area 2 (WA)**
- **Onslow Prawn Managed Fishery (WA)**
- **Pilbara Trap Managed Fishery (WA**
- **Pilbara Line Fishery (WA)**
- **Octopus Developmental Fishery (WA)**

These fisheries will be Jadestone's focus for consultation. Consultation for other fisheries will take place through notification of State and Commonwealth representative bodies or directly if requested by representative bodies.

In the unlikely event of a hydrocarbon spill, Jadestone Energy will conduct extensive and immediate consultation with other fisheries licensed to operate within the broader Environment that May be Affected (EMBA) by such a spill.

Potential risks to fishing sector

A summary of potential risks to the fishery sector that are common to both Environmental Plan activities is provided below. For each risk the associated management measures are summarised in Table 1.

TABLE 1: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES COMMON TO BOTH ENVIRONMENT PLANS

Potential Risks	Mitigation and /or Management Measures
Light Emissions	• Potential impacts from lighting are assessed as occurring within 20 km of a vessel or facility based on the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019) • Facility and vessel navigation lights are compliant with the Navigation Act 2012
Noise Emissions	• Vessels and helicopters comply with relevant parts of EPBC Regulation (2000) Part 8 • Vessel and machinery are maintained in accordance with Flag State certification requirements • All engines, compressors and machinery on the CPF and MODU are maintained via a maintenance management system
Atmospheric Emissions	• Flag State Certificate and/or IAPP certifies measures are in place to manage air emissions • All engines, compressors and machinery on the CPF and MODU are maintained via a maintenance management system
Operational discharges	• Emissions and discharges of liquid waste to sea are in accordance with legislative requirements, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna • Waste Management Plan
Interaction with other users	• A pre-existing 500 m restricted zone is in place around the facility and will remain in place for the duration of operations under the proposed EPs, including during the drilling activity as the MODU will be within the 500m restricted zone of the CPF. No fishing vessels are to enter this zone • Commercial fishers are permitted to enter the wider 3Nm cautionary zone and fish, transit or anchor for the duration of operations under the proposed EPs, as long as it is safe to do so • Notice to Mariners and charts will show zones
Interaction with fauna	• Vessels operating within the restricted zone must not exceed a speed of five (5) knots • Induction includes information on speed limits and requirements for interacting with marine fauna
Physical Presence	• Seabed disturbance limited to planned activities and defined locations

In addition to the risks outlined in Table 1, the risk of produced water discharge is specific to the Stag Operations EP activities (Table 2).

TABLE 2: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES ASSOCIATED ONLY WITH STAG 5 YEAR OPERATIONS EP

Potential Risks	Mitigation and /or Management Measures
Produced water discharges	• Beyond temporary perturbation to water quality, no environmental impacts due to the discharge of produced water are expected • Produced water discharges are monitored and recorded with adaptive management processes in place if significant changes are identified

In addition to the risks outlined in Table 1, the risk of drilling discharges is specific to the Stag Drilling EP activities (Table 3).

TABLE 3: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES ASSOCIATED ONLY WITH STAG DRILLING EP

Potential Risks	Mitigation and /or Management Measures
Drilling discharges	• Selection process for materials as part of NOPSEMA approval • Process for inventory control to minimise leftovers • Cuttings management system in place to manage muds (no synthetic based muds planned for use)

Additional risks that are associated with events that are not expected to occur during normal activities are outlined in Table 4.

TABLE 4: POTENTIAL RISKS AND MITIGATION/MANAGEMENT MEASURES ASSOCIATED ONLY WITH UNPLANNED EVENTS

Potential Risks	Mitigation and /or Management Measures
Introduced Marine Species (IMS)	• IMS Management will meet legal requirements and reduce risks to ALARP and Acceptable levels. • Vessels will be required to adhere to ballast water management, quarantine and biofouling requirements if required
Unplanned discharges	• No release of non-hazardous / hazardous solid wastes or non-hydrocarbon hazardous liquids to the marine environment • Dropped object prevention • Waste management plan implemented, and details included in induction materials • Spill kits available and incident response plans in place
Vessel/MODU collision	• Marine notifications will be made to relevant stakeholders, describing the location of the activity and a 500 m petroleum safety zone is present to prevent the risk of collisions • Vessels operating within the restricted zone must not exceed a speed of five (5) knots • Simultaneous Operations (SIMOPS) plan in place to interface between the Stag facility and MODU during drilling • Navigation lights installed and checked
Hydrocarbon release	• Oil Pollution Emergency Plan • Procedures in place on CPF to prevent hydrocarbon release to sea during operations • Procedures in place on MODU to prevent hydrocarbon release to sea during drilling • Appropriate vessel spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment

Providing Feedback

If you would like to comment on the proposed activity outlined in this fact sheet or would like additional information, please contact Jadestone before Monday 20th December 2021. Feedback can be provided at any time before/during or after the activity.

Phone: 08 9486 6600 Email: consult@jadestone-energy.com
Our Perth office is located at: The Atrium, Level 2, 168 St Georges Terrace, Perth WA 6000

Any person providing feedback is asked to advise if this information is to remain confidential and they do not wish it to be published within the Environment Plan.

APPENDIX F – PROTECTION PRIORITY VALUES AND SPILL MODELLING SUMMARY

Key: NM = Not Modelled; NC = Not Contacted. Also note the worst case is represented for each value but could be from different seasons.

Protection Priority	Key Values	Relevant Key Periods (Vulnerability)	Oil Spill Modelling Parameter		Scenario Result	
					Subsea Crude ($86.5m^3$)	Surface Marine diesel ($250m^3$)
Dampier Archipelago	**Physical Habitats** Coral reefs -approximately 120 species of coral - significant (>70% coverage) are on slopes of eastern half of archipelago -high sponge diversity Seagrass -largest areas between Keast and Legendre Is, and West Intercourse Is and Cape Preston -takes forms of interspersed seagrass/macroalgal beds rather than extensive meadows Macroalgae -macro-algae dominate shallow (<10m) submerged limestone reefs and grow on stable rubble and boulder surfaces -approx. 200 species -counts for 70% of marine habitat Mangroves - throughout area but EPA regionally significant at West Intercourse and Enderby Is Intertidal mud/sand flats -wide sandflats and mudflats Sandy Beaches -present and used for turtle and seabird nesting	Turtle nesting and breeding Nov-Mar with peak in late Dec/early Jan. Humpback whale annual migration July to September	Probability of films arriving at receptors at $>1g/m^2$	%	<1	<1
			Probability of contact by floating oil at $>10g/m^2$	%	<1	<1
			Probability of contact by entrained oil at >100ppb	(%)	<1	<1
			Probability of contact by dissolved aromatics at >70 ppb	(%)	<1	<1
			Maximum accumulated volume on shorelines with concentrations exceeding 100 g/m^2	m^3	19	NC
			Minimum time to shoreline contact by floating oil at >100 g/m^2	days	7	NC
			Maximum concentration of	ppb	44	40

	Contact from floating oil is likely to impact emergent coral and sandy beaches resulting in smothering of coral and stranded oil on beaches, although tidal movements will mobilise oil and add to dispersion of oil. Contact from entrained oil may impact submerged corals/seagrasses/macroalgae resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution **Marine Fauna** Invertebrates -abundant, molluscs Finfish and Rays -high fish biodiversity approx. 650 species, dwarf sawfish EPBC protected - outer islands of the Archipelago are inhabited predominantly by coral reef fishes whereas inner areas close to the mainland are occupied by mangrove and silty-bottom dwellers -inter-island passages have rich soft bottom fauna Birds -16 species of seabirds, some protected under EPBC, JAMBA and CAMBA species with significant breeding on Goodwyn, Keast Islands, Nelson Rocks -migratory seabird resting, foraging and breeding areas on beaches and mudflats -breeding occurs predominantly in winter months -nesting can occur on sandy beaches and dunes Marine reptiles Turtles - nesting and foraging (Hawksbill - largest known nesting for NW pop is NW of Rosemary Is and Delambre, nesting all year) (Flatbacks - nest on Legendre, Huay, Delambre)		entrained oil in the worst replicate			
			Maximum concentration of dissolved aromatics in the worst replicate	ppb	7	5

	(Green – significant rookery in NWS) (Olive Ridley – known to forage) (Loggerhead – nesting and foraging) Seasnakes - possible transient presence Marine mammals - Eight species (dugong, whales, dolphins) - migratory pathway for protected humpback whale in July-Sept. Contact from floating oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate), oil coating from movement across shorelines and inhalation of oil if surfacing to breathe. In addition, ingestion may occur from preening/cleaning body and/or eating tainted food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin or eye irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food or breathing oil entrained water (fish). Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile **Protected Area** - Commonwealth Marine Reserve The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the CMR values **Socio-economic and heritage values** -National Heritage Listed -Aboriginal rock art on shorelines, Burrup Peninsula -42 islands within 45km radius of Dampier -25 islands are nature reserves -Recreational fishing (high values by community) -Camping beaches, social amenities -High use port for shipping and industry and shipping fairway					

	-Aquaculture -Aquarium fishery -tourism around water based activities and nature (whale watching and turtles) Shipwreck sites Oil contacting will impact upon these values, in particular, tourism, industry, indigenous values and fishing activities being impacted from visible floating oil and tainted fish					
Barrow Island Inc. surrounds	Bandicoot Bay - conservation area created to protect benthic fauna and seabirds. Class A Nature Reserve *Note that there is No Contact by Dissolved Oil above the threshold* **Physical Habitats** Coral reefs - Biggada Reef Seagrass - No significant meadows, some present in shallow areas Macroalgae - Dominant benthic habitat on hard substrates (~40%) Mangroves - Some restricted areas of stunted growth mangroves Sandy beaches - Important beaches for turtle nesting (Green & Flatback) Rocky shorelines - Cliffs up to 30 m high - Some intertidal limestone platforms provide food for shorebirds Intertidal mud/sandflats - largest intertidal sand/mudflat community in the reserves, high in invertebrate diversity - important feeding area for migratory birds	Green turtle nesting: All year round (peak Dec-Jan) Hawksbill turtle nesting: Oct-Jan Flatback turtles: Dec-Jan Loggerhead nesting: Dec-Jan Birds: Sept-Feb	Probability of films arriving at receptors at >1g/m^2	%	1	<1
			Probability of contact by floating oil at >10g/m^2	%	<1	<1
			Probability of contact by entrained oil at >100ppb	(%)	1	2
			Probability of contact by dissolved aromatics at >70 ppb	(%)	<1	<1
			Maximum accumulated volume on shorelines with concentrations exceeding 100 g/m^2	m^3	2	NC
			Minimum time to shoreline contact by floating oil at >100 g/m^2	Days	26	NC
			Maximum	ppb	2	544

	KEF Contact from floating oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation and may impact submerged corals/seagrasses/macroalgae resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution. **Marine Fauna** Invertebrates - High invertebrate density on mud/sand flats - Diversity typical of NWS and Indo-Pacific region - Filter feeding communities dominant >10m depths Turtles - Regionally and nationally sig Green (western side) and flatback turtle (eastern side) nesting beaches, - Foraging and nesting areas around Barrow Island for green, flatback and hawksbill; mating flatback turtles; - John Wayne Beach, logger heads + hawksbill (low density) - Turtle Bay is an important turtle aggregation and feeding area Seabirds - Migratory birds (important habitat) (important bird area) 10th of top 147 bird sites, - Highest pop of migratory birds in BI Nature reserve (south-south east island) and in tidal mudflats e.g. Bandicoot Bay - Along the East Asian-Australasian Flyway migration route of migratory sea and shorebirds - Double island important bird nesting (shearwaters, sea eagles) Fish/sharks		concentration of entrained oil in the worst replicate			
			Maximum concentration of dissolved aromatics in the worst replicate	ppb	343	30

	- Intertidal flats provide foraging habitat for sharks/rays at high tide - High species richness and diversity of fish fauna >400 species Marine mammals Fish - Similar species found throughout Indo-west Pacific region - Blind gudgeon found at Barrow Island (in caves/groundwater) Seabirds - Foraging area for Migratory and seabirds Marine mammals - Whale and dolphin species may occasionally visit the Barrow/Montebello islands region Contact from floating oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate), oil coating from movement across shorelines and inhalation of oil if surfacing to breathe. In addition, ingestion may occur from preening/cleaning body and/or eating tainted food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin or eye irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food or breathing oil entrained water (fish). Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile **Socio-Economic and Heritage values** National heritage - Barrow Island and Montebello-Barrow Islands CMR - Barrow Island marine park is zoned a sanctuary zone. Commonwealth Marine Reserve and Barrow Island MMA and Montebello Islands MP (Multiple Use) The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the marine park values Commercial fishing - Pearling leaseholders in the area, some zones prohibit pearling					

	- A number of State managed fisheries occur in the area Tourism - Nature based tourism (charter vessels, diving snorkelling) - Limited visitors given remote location - Shore based fishing - Marine park allows passive recreational activities (diving, snorkelling, boating) - Very important for recreational fishing - Significant for recreational fishing and charter boat tourism Cultural Heritage - No recorded seabed Aboriginal sites Recreational Fishing - Significant for recreational fishing and charter boat tourism Industry - Oil and gas facility and pipelines, RO Plant and operations Oil contacting will impact upon these values from visible floating oil and stranded oil					
Montebello Islands, inc. CMR	Montebello Islands are important for turtle nesting and seabirds. Montebello CMR is in place to protect foraging areas for migratory seabirds, whale sharks and marine turtles; includes part of the migratory pathway of the humpback whale. - The reserve includes shallow shelf environments with depths ranging from 15 metres to 150 metres and provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features - Examples of the seafloor habitats and communities of the Northwest Shelf Province provincial bioregions as well as the Pilbara (offshore) meso-scale bioregion - One key ecological feature for the region: ancient Coastline (a unique seafloor feature that provides areas of enhanced biological	Pygmy blue whale migration: Apr-Aug	Probability of films arriving at receptors at >1g/m^2	%	8	<1
			Probability of contact by floating oil at >10g/m^2	%	1	<1
			Probability of contact by entrained oil at >100ppb	(%)	2	40
			Probability of contact by dissolved aromatics at >70 ppb	(%)	<1	2

	productivity) is represented in this reserve - Important for recreational fishing Contact from entrained and dissolved oil may impact submerged habitats resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution **Physical Habitats** Reefs Algae (40%) Mangroves (globally unique as offshore) Fish habitat Intertidal sand flat communities Contact from floating oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation and may impact submerged corals/seagrasses/macroalgae resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution **Marine Fauna** Turtles - Logger head, green significant rookery, hawksbill, flatback - Northwest and Eastern Trimouille Islands (Hawksbill), western reef and Southern Bay at Northwest Island (Green) Seabirds - Migratory and threatened seabirds - 14 species - Significant nesting, foraging and resting areas Invertebrates - Filter feeding communities dominant >10m depths		Maximum accumulated volume on shorelines with concentrations exceeding 100 g/m^2	m^3	33	NC
			Minimum time to shoreline contact by floating oil at >100 g/m^2	Days	NC	NC
			Maximum concentration of entrained oil in the worst replicate	ppb	1,288	5,973
			Maximum concentration of dissolved aromatics in the worst replicate	ppb	34	168

	Fish - Similar species found throughout Indo-west Pacific region Marine mammals - Whale and dolphin species may occasionally visit the Barrow/Montebello islands region - Only the humpback whale is a regular visitor to these areas (foraging) - Pygmy blue whale northern migration (Apr - Aug) - Dugongs regularly seen in shallow waters Marine Reptiles - Foraging area for marine turtles Contact from floating oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate), oil coating from movement across shorelines and inhalation of oil if surfacing to breathe. In addition, ingestion may occur from preening/cleaning body and/or eating tainted food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin or eye irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food or breathing oil entrained water (fish). Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile **Socio-Economic and Heritage values** Pearling (inactive/pearling zones) Significant for recreational fishing and charter boat tourism Marine park allows passive recreational activities (diving, snorkelling, boating) Social amenities and other tourism European history/maritime heritage Nominated place (National heritage) Commonwealth Marine Reserve and and Montebello Islands MP (Multiple Use)					

	Cultural heritage: No recorded Aboriginal sites Oil contacting will impact upon these values from visible floating oil and stranded oil					
Lowendal Islands	**Physical Habitats** - Important shallow lagoons with seagrass for dugongs - Deep water benthic (soft sediment) habitats - Dugong and batman reef (eastern side IS), - Mangroves are considered globally unique as they are offshore - Macro algal reefs (40%) Contact from floating oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation and may impact submerged corals/ seagrasses/ macroalgae resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution **Marine Fauna** Turtles - Important hawksbill (Beacon, Parakeelya, Kaia and Pipeline), Loggerhead and green turtle nesting (minor) Varanus pipeline, Harriet and Andersons), - Nesting is reported to occur throughout the year in WA, peaking between October and January - Significant Flatback rookery, nesting season for Flatback turtles peaks in December and January with subsequent peak hatchling emergence in February and March Seabirds - Approximately 89 species of avifauna, 12 -14 species of migratory and seabirds Marine mammals	Green turtle nesting: All year round (peak Dec-Jan) Hawksbill turtle nesting: Oct-Jan Flatback turtles: Dec-Jan Loggerhead nesting: Dec-Jan Birds: Sept-Feb	Probability of films arriving at receptors at >1g/m^2	%	<1	<1
			Probability of contact by floating oil at 10g/m^2	%	<1	<1
			Probability of contact by entrained oil at >100ppb	(%)	<1	2
			Probability of contact by dissolved aromatics at >70 ppb	(%)	<1	<1
			Maximum accumulated volume on shorelines with concentrations exceeding 100 g/m^2	m^3	7	NC
			Minimum time to shoreline contact by floating oil at >100 g/m^2	days	26	NC
			Maximum concentration of entrained oil in the worst replicate	ppb	<1	424
			Maximum concentration of	ppb	2	16

	- Seagrass beds around the Lowendal islands thought to provide valuable food source for dugongs Contact from floating oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate), oil coating from movement across shorelines and inhalation of oil if surfacing to breathe. In addition, ingestion may occur from preening/cleaning body and/or eating tainted food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin or eye irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food or breathing oil entrained water (fish). Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile **Protected Areas** - The Barrow Island Marine Management Area most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park. [See Barrow Island and Montebellos for information] The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the MMA and marine park values **Socio-economic and Heritage values** - Social amenities and other tourism, Very significant for recreational fishing and charter boat tourism Oil contacting will impact upon these values from visible floating oil and stranded oil		dissolved aromatics in the worst replicate			
Greater North Coast/Eighty Mile Beach; inc. CMR and Ramsar Site	Eighty Mile Beach management plan recognises oil spills as a potential pressure on emergent features: mangroves and saltmarsh, intertidal sand and mudflats (DPaW, 2014). CMR in place to protect communities and seafloor habitats, Eighty Mile Beach marine park also in place. **Physical Habitat** Coral reefs - Subtidal filter feeding communities present, likely provide foraging habitat for flatback turtles	Birds: Aug-Nov Nesting Turtles: Nov-Dec Hatchling turtles: Feb-Mar	Probability of films arriving at receptors at >1g/m^2	%	1	<1
			Probability of contact by floating oil at 10g/m^2	%	<1	<1
			Probability of contact by entrained	(%)	<1	<1

	- High diversity intertidal and subtidal coral reef communities Seagrasses - Seasonally present but sparsely distributed - Dugongs regularly found feeding on seagrass meadows here Macroalgae - Provide habitat and feeding opportunities for fish, invertebrates and dugong Mangroves - Limited stretch along coastline and in Mandora Saltmarsh area. minor stands 10-20 km close to tidal creeks. Intertidal mud/sand flats - 225km intertidal mudflats provide important food source for many of the bird species from the infauna present - Mandora Saltmarsh area contains rare group of wetlands Sandy Beaches - Sandy shores occupy the landward edge of the intertidal zone (approx. 220km), provide important turtle nesting habitat and some tourism (see below). Rocky shorelines - Not identified in emergent area Contact from floating oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained and dissolved oil (although well below threshold levels) may impact submerged habitats resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution		oil at >100ppb			
			Probability of contact by dissolved aromatics at >70 ppb	(%)	<1	<1
			Maximum accumulated volume on shorelines with concentrations exceeding 100 g/m^2	m^3	7	NC
			Minimum time to shoreline contact by floating oil at >10 g/m^2	DAYS	NC	NC
			Maximum concentration of entrained oil in the worst replicate	ppb	<1	15
			Maximum concentration of dissolved aromatics in the worst replicate	ppb	<1	<1

	Marine Fauna Invertebrates - Large number and diversity of invertebrates within the intertidal mudflat areas - Oil can reduce invertebrate abundance or alter the intertidal invertebrate community that provides food for non-breeding shorebirds Fish and sharks - Fish populations dependent on habitat and substrate type - Several fish species targeted by recreational commercial fisheries - Sawfish foraging, nursing and pupping; diversity of sharks and rays (including protected species) - Diversity of fish species provide recreational and commercial fishing opportunities Birds - Ramsar site - 97 wetland bird species, 42 of which are listed under CAMBA, JAMBA and ROKAMBA - 500,000 birds use the area as a migration terminus annually, key period is Aug-Nov when contact with oil spill could result in impacts at a population level Marine reptiles - Flatback turtles nest at scattered locations along shoreline. - Green , hawksbill, loggerhead, olive ridley and leatherback may frequent the waters all year round Marine Mammals - Humpback whale migration pathway though the CMR - Dugongs and other cetaceans inhabit or migrate through the CMR/marine park although unlikely to be larger whale species due to water depths					

	Contact from floating oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile **Protected Area** - Listed Ramsar site. The site comprises of two separate areas: 220km of beach and associated intertidal mudflats from Cape Missiessy to Cape Keraudren ("the beach") and Mandora Salt Marsh 40km to the east (inland). Oil unlikely to contact Mandora Salt Marsh, however 'the beach' area consists of sandy beach, mangroves and intertidal mudflats which may be contacted by oil (as described above) impacting upon the Ramsar values **Socio-economic and heritage values** - Tourism activities include camping nearby, nature appreciation, nature based, fishing and wildlife viewing from vessels. Some vessel based fishing (mostly shore based recreational fishing in Eighty Mile Beach area) and four wheel driving - Indigenous values: wetlands are significant to 3 local groups, several aboriginal heritage sites present. The adjacent CMR contains land and sea important to traditional indigenous owners, 4 special purpose zones included in marine park Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish - Heritage value: two shipwrecks and one plane wreck present that could be contacted by entrained oil - Pearl Producers Association have previously indicated this is area is important as a seed stock. Diving for pearl oysters is limited to					

	the 35m depth contour (adjacent to the marine park) - Commercial fishing: a number are licensed to operate in the CMR The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the CMR and socio-economic values					